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BLEACHING ◆ DYEING ◆ FINISHING ◆ PRINTING

VOLUME 26 | OCTOBER 4, 1937 | NUMBER 20

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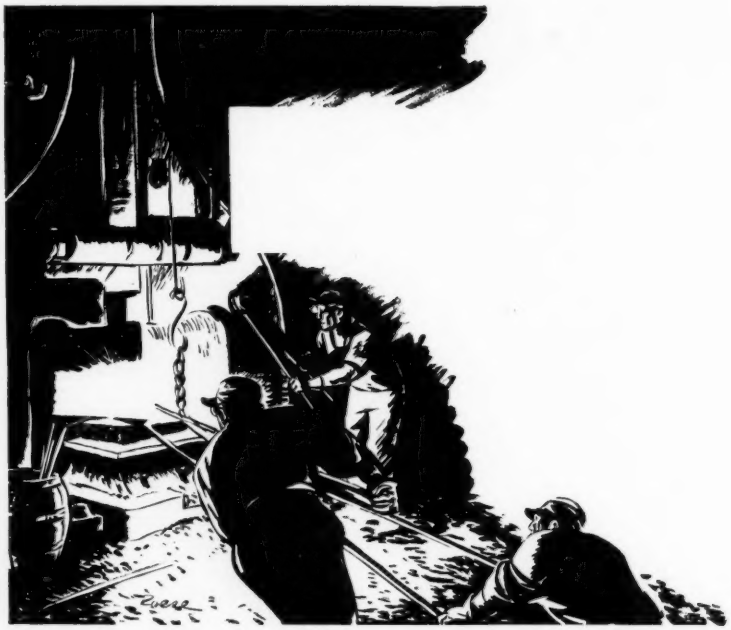

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Official Publication of the American Association of Textile Chemists and Colorists

THE OBJECTS OF THIS ASSOCIATION ARE:

"To promote increase of knowledge of the application of dyes and chemicals in the Textile Industry.

"To encourage in any practicable ways research work on chemical processes and materials of importance to the Textile Industry.

"To establish for the members channels by which the interchange of professional knowledge among them may be increased."

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AMERICAN
DYESTUFF REPORTER

VOLUME 26 OCTOBER 4, 1937 NUMBER 20

Identification of Vat Dyestuffs

on Textile Fibers

HECTOR C. BORGHETTY* and KENNETH J. BRODEN*

THE following is a translation, extension and adaptation of the original chart on Vat Color identification which appeared in the February-March issue of the *Bollettino dell' A.I.C.T.C.* of Milan, Italy. The writers wish to give due credit to the author, Professor G. Buzzi-Ferraris who established the procedure of the reactions and compiled the bulk of the chart.

In adapting and checking the work for American use it has been found necessary to simplify eliminating several of the trade names and to use only the common Indanthrene-Algol and Cibanone-Ciba types.

Colour Index numbers have been added wherever possible. American made types can be cross-indexed readily by means of the ALPHABETICAL LIST which appears in the YEAR BOOK of our own Association. Colors which have no Colour Index number (and unfortunately this is often the case) have been indexed in a few instances with the prototype number which appears in the YEAR BOOK of the A.A.T.C.C.; others have been listed with the most recent name used.

The chart is complete as far as the better known Vat Colors are concerned. If, however, a color under examination is not found on the chart, it will be necessary then to investigate the newer brands of dyestuffs which appear on the market and establish their reactions.

This method can be used for the rapid identification of Vat Colors, dyed or printed, on vegetable fibers. It involves five main reactions, two of which are necessary to divide the various dyestuffs into four different groups, while the remaining three are used to determine the characteristics of the individual dyestuffs.

The two Reagents for the purpose of ascertaining the four groups are:

(a) Alkaline Hydrosulfite
(b) Concentrated Sulfuric Acid.

The dyed or printed fabric when spotted with the above generally shows a change of color which is rated in the manner of its increase or decrease in tone. This change is interpreted as follows:

Direction of Tone Increase

Yellow, Orange, Scarlet, Brown, Violet, Blue, Green, Olive, Grey, Black.

Direction of Tone Decrease

The various dyestuffs then fall into four categories:

	Alkaline Hydrosulfite	*Concentrated Sulfuric Acid*
I.	Increase of Tone	Increase of Tone
II.	Increase of Tone	Decrease of Tone
III.	Decrease of Tone	Increase of Tone
IV.	Decrease of Tone	Decrease of Tone

A slight variation of color is recorded as a Decrease.

Following the above procedure, the assignment of a dye to one group or the other is relatively simple because the only observation necessary is that of noting the change in color and recording it as an Increase or Decrease—according to whether it has moved in the direction of Yellow to Black or vice-versa.

Furthermore, this method has the advantage of being practical when merely a few colored threads of the sample are available, on the condition that they be dyed in a shade of medium strength.

The Laboratory routine for the five reactions is as follows:

Reaction I. *Alkaline Hydrosulfite* (see Reagents) is applied with a glass rod and a few seconds are allowed to elapse before recording the eventual change in color or the formation of a halo.

Reaction II. *Acid Hydrosulfite.* Take the sample used for the first test and squeeze it between two pieces of filter paper and then spot it immediately with the dilute Sulfuric Acid. Note any change in color—(This reaction is conveniently carried on immediately after No. I; it is not, however, the reaction which places the dyestuffs in one of the four groups).

Reaction III. *Concentrated Sulfuric Acid.* Take a new sample and spot it with Concentrated Sulfuric Acid, observing the change of shade and also the color of the disintegrated fiber. This can be observed when flattening on a porcelain plate.

* The Aspinook Company, Jewett City, Conn.

Reaction IV. *Nitric Acid.* Another small piece of sample is placed in the center of a filter paper which has been folded in four. It is spotted with several drops of Nitric Acid while observing carefully the change in shade. Squeeze the sample between the filter paper and note the color of the stain and of the sample.

Reaction V. *Stannous Chloride.* Spot the sample and filter paper used in No. IV and note any change in shade.

The above reactions differentiate the various dyestuffs which are listed in the following tables. It must be borne in mind that Reactions I and III determine in which of the four groups the dyestuffs are to be located.

The dyestuffs toward the end of the chart, that is, in the region of the Blacks, Greys, Olives and Browns, have been reduced considerably in number because with a few exceptions these are usually mixtures. Furthermore, Blacks being the natural outlet for the mistakes of the dyer and printer, are generally difficult to detect.

In rating the color formations of the reactions it must be remembered that a few seconds should elapse before making any notation. This is particularly important in Reaction No. 2 where the object of the Acid Hydrosulfite is to obtain the color of the leuco compound and not that of its alkaline salt.

REAGENTS

Alkaline Sodium Hydrosulfite

10 gms. Sodium Hydrosulfite (anhydrous) are dissolved in 100cc Sodium Hydroxide (10cc of 36°Be NaOH in 90cc H_2O).

N. B. This solution must be freshly prepared.

Concentrated Sulfuric Acid

Use 58°-60°Be as this strength is the only one suitable to obtain results corresponding to those of the chart.

Dilute Sulfuric Acid

10cc Sulfuric Acid 58°-60°Be)
90cc H_2O) Dilute with care.

Concentrated Nitric Acid

Must be colorless and have a specific gravity of 1.40-1.45 (about 41°Be).

Stannous Chloride

10 gms. Stannous Chloride.
100cc—10% Hydrochloric Acid.
Filter if necessary before using.

Pyridine and Benzol should also be kept handy for the identification of a few dyestuffs which are apt to create confusion.

ABBREVIATIONS

It was found that abbreviations were necessary to maintain as compact a chart as possible.

Y—Yellow	Bo—Bordeaux	Ol—Olive
Or—Orange	Br—Brown	Gr—Grey
R—Red	Vi—Violet	Blk—Black
Sc—Scarlet	Bl—Blue	
Cr—Crimson	G—Green	

-s-indicates that the color is not clear but sullied by impurities.

n.v.—No variation	sol. c—Soluble (cold)
st.—Stains	sol.w—Soluble (warm)
n.st.—Non staining	fluor—Fluorescent
slt.—Slightly	t.—Turns
int.—Intensely	str.—Strongly
dk.—Dark	dec.—Decolorizes
lt.—Light	c.r.—The color returns
Pro.—Prototype	
F—Fiber	P—Paper (filter)

GROUP I

No.	Trade Name of Color	Colour Index No.	HYDROSULFITE Alkaline	HYDROSULFITE Acid	Sulfuric Acid	Nitric Acid	Stannous Chloride	REMARKS
1.	Indanthrene Yellow FFRK (purified Yell. RK type)		Br-Or	Y-G-s	Or-Y-s	F—n.v. P—n.v.	F—n.v. P—n.v.	
2.	Indanthrene Yellow G	1118	Bl	G	Or-Y-s	F—Or P—st.Or	F—Br then G P—G-Bl	sol. w. Benzol G-Y, sol. w. Pyridine G-Y
3.	Indanthrene Yellow RK		Or-Br	Y-G-s	Cr then t. Br	F—n.v. P—n.v.	F—n.v. P—n.v.	slt. sol. w. Benzol Y slt. sol. w. Pyridine Y-G
4.	Indanthrene Yellow 3R (purified brand of 3RT)		Br-Vi-s	Y	Br-Vi	F—t.R P—n.v.	F—n.v. P—n.v.	
5.	Indanthrene Yellow 3RT		Br-R-s	Y-G-s	t. Br	F—n.v. or slt. Or P—n.v.	F—n.v. P—n.v.	
6.	Ciba Yellow G	1196	t. Br	n. v.	Or-R	F—Or P—st.Or.s	F—c.r.Y P—c.r.Y	
7.	Cibanone Yellow 3GK		Br G. fumes	Bl	Or-Br	F—n.v. P—n.v.	F—n.v. P—n.v.	slt. sol. w. Pyridine, Y coloration
8.	Cibanone Yellow 2G		Br	Y	Or-s	F—t.R P—slt.st.	F—n.v. P—n.v.	
9.	Cibanone Yellow R	1170	Br-Blk	Y	R-Vi-s	F—slt.Reddish P—n.v.	F—n.v. P—n.v.	slt. sol. w. Pyridine, Y coloration

No.	Trade Name of Color	Colour Index No.	HYDROSULFITE Alkaline	HYDROSULFITE Acid	Sulfuric Acid	Nitric Acid	Stannous Chloride	REMARKS
10.	Ind. Golden Yellow GK		R	Y	Vi-R	F—n.v. P—n.v.	F—n.v. P—n.v.	
11.	Ind. Golden Yellow RK		R	Y	Vi	F—n.v. P—n.v.	F—n.v. P—n.v.	
12.	Ind. Yellow Brown 3G	Pro. 103	Or-Br	Y	G-s then Br-Y	F—n.v. P—n.st.	F—n.v. P—n.v.	
13.	Cibanone Golden Orange 2R Ind. Orange RRTS	1097	Vi-R-s	Or	Bl-Vi	F—Br-R P—slt.st.	F—n.v. P—n.v.	sol. c. Benzol Y-Br sol. w. Pyridine Y
14.	Indanthrene Orange 4R Cibanone Orange 8R		Vi-R	Or	Bl-Vi-s	F—Br-R-s P—n.st.	F—R-Or P—n.v.	
15.	Cibanone Orange R	1169	Bo-Br.Or	Or-Y.Ol	Br	F—Or-R P—slt.st.	F—Or-S P—n.v.	
16.	Ciba Orange G	1230	t. Br	Or	Br-Blk	F—G-Blk P—st.G-Blk	F—c.r. P—c.r.	
17.	Ind. Brill. Orange GK		Vi-s	Or	G-Br-s	F—R (dkr. than with the RK types) P—st.slt.R	F—n.v. P—n.v.	
18.	Ind. Brill. Orange RK (purified brand of Ind. Org. 4R)	Pro. 100	Vi	Or	G-Br-s	F—R P—st.slt.	F—R P—R	
19.	Ind. Golden Orange 3G		Br	Y	from G to heavy dull Bl-G.	F—n.v. P—n.v.	F—n.v. P—n.v.	
20.	Ind. Golden Orange G	1096	Cr	Br.	Bl.slt.Vi	F—n.v. P—n.v.	F—n.v. P—n.v.	sol. w. Benzol G-s
21.	Indanthrene Red GG		Vi-R	slt. more Or.	Brill.R-Vi	F—n.v. P—st.R	F—n.v. P—n.v.	G fluor. in Benzol In mixtures this color gives fluor. with conc. H_2SO_4
22.	Ind. Printing Red G		Br-Vi then dk. Br	R	dk. Vi	F—slt. more Y P—n.st.	F—n.v. P—n.v.	
23.	Ind. Red Brown R		Br-Vi	R-Br-R	Ol-Br-Blk	F—n.v. or slt. R P—st.R.Br	F—n.v. P—n.v.	
24.	Indanthrene Brown 3GT		dk. Br	Br	Vi-Br	F—G-Ol then Or-s P—st. Or	F—n.v. P—n.v.	
25.	Indanthrene Brown 3R		dk. Vi	Or	Ol-Br	F—n.v. P—st. in original shade	F—n.v. P—Ol-Br-s	Resembles Ind. Orange 3R and (or) mixtures of Algol Yellow GC
26.	Cibanone Brown R		Br-Blk-s	Br	Br-Blk	F—n.v. or slt. Vi P—st.slt.Vi	F—n.v. P—n.v.	sol. w. Pyridine Br
27.	Indanthrene Violet B	1105	Bl	Vi	G-Blk	F—G-Blk P—st. G-Blk	F—n.v. P—Bl-Blk	Strong R fluor. in Benzol
28.	Cibanone Violet R Ind. Violet R extra	1103	Vi-Bl-s	Vi	G	F—Vi-Gr P—Y-G-s	F—Vi P—Bl-G	sol. w. Benzol with Or fluor. sol. c. Pyridine with R fluor.
29.	Cibanone Violet 2R		Bl	Vi-R		F—G-s P—st. G	F—Vi-s P—Bl-G	sol. w. Benzol with Or-R fluor. sol. w. Pyridine with Or-R fluor.
30.	Cibanone Violet 4R Ind. Brill. Violet 4R	Pro. 101	clear Bl	clear Vi-R	Emerald Green	F—slt. R P—n.st.	F—n.v. P—n.v.	sol. w. Benzol with Or-R fluor. sol. w. Pyridine with Or-R fluor.
31.	Cibanone Violet 2RB Ind. Brill. Violet RR (purified brand of Cibanone Violet 2R)	1104	clear Bl	clear Vi-R	Emerald Green	F—slt. R P—n.st.	F—n.v. P—n.v.	sol. w. Benzol with Or-R fluor. sol. w. Pyridine with Or-R fluor.

No.	Trade Name of Color	Colour Index No.	HYDROSULFITE Alkaline	HYDROSULFITE Acid	Sulfuric Acid	Nitric Acid	Stannous Chloride	REMARKS
32.	Ind. Brill. Violet 3B		clear Bl	clear Vi-R	Emerald Green	F—slt. redder P—n.st.	F—n.v. P—n.v.	sol. w. Benzol with Or-R fluor. sol. w. Pyridine with Or-R fluor.
33.	Ciba Indigo R Indigo MLB-R Indigo BASF-R	1182	G-Y-s*	t.Bl	slt. Greener thenGr. st. filter paper R-s	F—color is completely destroyed P—st. Or	F—n.v. P—n.v.	slt. sol. w. Pyridine Bl.
34.	Ciba Indigo 2R		G-Y-s*	t.Bl	slt. greener then Gr. in dk. shades. st. filter paper R-s.	F—color is completely destroyed P—st. Or	F—n.v. P—n.v.	slt. sol. w. Pyridine Bl.
35.	Ciba Blue 2G		G-Y-s*	t.Bl	slt. G.	F—not completely destroyed P—st. slt. Or	F—slt. G P—slt. G	As No. 34: A drop of Sn Cl_2 on the fiber which has been previously wet out with HNO_3 gives a greener tint than with Ciba Blue G.
36.	Ciba Blue G	1185	G-Y-s*	t.Bl	slt. G.	F—not completely destroyed P—st. slt. Or	F—slt. G P—n.v.	As No. 35:
37.	Ciba Blue BR Brill. Indigo BASF-B	1190	G-Y-s* dkr. than previous brands	t.Bl	slt. G.	F—color is completely destroyed P—st. Or	F—n.v. P—n.v.	As No. 34: The HNO_3 reaction destroys the color more completely than with the R and 2R brands which usually show a slt. Y tint.
38.	Ciba Blue 2B Brill. Indigo 4B—4BC	1184	G-Y-s*	t.Bl	slt. G.	F—color is completely destroyed P—st. Or	F—n.v. P—n.v.	As No. 37:
39.	Ind. Navy Blue BRF		Bl	Cr	G-Ol	F—Navy P—n. st.	F—n.v. P—n.v.	
40.	Ind. Navy Blue R		Bl	Vi	G	F—Navy P—n. st.	F—n.v. P—n.v.	

* Colors numbered 33, 34, 35, 36, 37 and 38 change from G-Y-s to Y-G-s and therefore at times are liable to appear as if in Group III.

GROUP II

41.	Indanthrene Yellow 5GK		R-Vi with Or halo	Y-Or	n.v.	F—n.v. P—n.v.	F—n.v. P—n.v.	slt. sol. w. Benzol Y
42.	Indanthrene Yellow 3GF		G-Ol	Y	n.v.	F—n.v. P—n.v.	F—almost n.v. P—almost n.v.	
43.	Indanthrene Yellow GF		Br-s slowly dec.	Or	n.v. or Y-Br	F—Y-s P—st. slt. Y	F—Y-G-s P—Y-G-s	sol. w. Benzol Y-G sol. c. Pyridine Y-G
44.	Indanthrene Yellow GK	1132	n.v. or grayer	Y	n.v. or s.	F—n.v. P—n.v.	F—n.v. P—n.v.	
45.	Algol Yellow GC	1095	Vi	R	Y-G-s	F—n.v. P—st. str. Y	F—Or P—Or	This color is not fast to light unless mixed with Anthraquinone Blues such as; GCD, 3G, BC, 3GT, 5G, RC, RS and Blue Green FFB in definite proportions.
46.	Cibanone Yellow 2GR		Br-Or	Y	n.v.	F—str. dec. P—st. Y	F—n.v. P—n.v.	sol. c. Benzol, Y.
47.	Ind. Brill. Orange GR		Br-G-s	G-Gr	Y-s	F—Y P—st. Y	F—Y-Br halo P—n.v.	
48.	Indanthrene Orange 2RK	1136	R-Br	Y	slt. Y-G-s	F—Y P—st. slt. Or	F—Or-Br P—n.v.	

No.	Trade Name of Color	Colour Index No.	HYDROSULFITE Alkaline	HYDROSULFITE Acid	Sulfuric Acid	Nitric Acid	Stannous Chloride	REMARKS
49.	Indanthrene Orange F3R		Vi-Br	Or	Y-s	F—int. Y P—st. str. Y.Or	F—n.v. P—n.v.	sol. w. Pyridine and w. Benzol. Y
50.	Indanthrene Orange 3R (Ind. Golden Orange 3R)		Vi	Or	slt. more Y then Y-s	F—slt. Yellower P—n. st.	F—n.v. P—n.v.	
51.	Cibanone Orange 2R		R-Br	Y	str. Y	F—Y P—st. str. Y-G-s	F—c.r. P—n.v.	sol. c. Pyridine, Or.
52.	Cibanone Golden Orange 2G		R-Bo	Y	Y halo	F—str. Y P—st. Y-G-s	F—c.r. P—c.r.	sol. c. Benzol and c. Pyridine, lt. Or.
53.	Indanthrene Scarlet R		Vi-R	Or-R-s	n.v. or slt. more Cr	F—n.v. P—n.v.	F—n.v. P—n.v.	
54.	Indanthrene Brown G Cibanone Brown BG	1152	Br-Vi-s	Y-s	R. Br-s	F—slt. redder P—n.v.	F—c.r. P—n.v.	
55.	Cibanone Brown GR Indanthrene Brown R	1151	Vi-s	Y	n.v. or R-Br	F—str. redder P—n. st.	F—n.v. P—n.v.	sol. w. Benzol and w. Pyridine, slt. Br.
56.	Ind. Printing Brown TM Suprafix		Vi-Br	Or-s Y-Br	Golden Or	F—Or-Y Br P—st. Or	F—slt.-s. P—Pink-Or varicolored	
57.	Indanthrene Scarlet GG		Br-G	G	n.v. or slt. more Y.	F—Y-Or P—st. slt. Or	F—Br Vi halo P—n.v.	
58.	Indanthrene Red RK	1162	Vi	Y-R-s	Or then slowly Br-Y.	F—Y-Or P—st. Y Or	F—c.r. P—c.r.	sol. w. Benzol R Bl sol. w. Pyridine R.
59.	Indanthrene Red BK		Vi-s	Or	Y-Or	F—n.v. P—n.v.	F—n.v. P—n.v.	sol. w. Benzol R Bl sol. w. Pyridine R.
60.	Indanthrene Red FBB		Vi-Br	Cr	Y-s	F—Y P—st. Y	F—n.v. P—n.v.	
61.	Indanthrene Red 5GK	1131	Vi-s t. Gr on boiling with Soda Ash.	Y-Or	Y-R-s	F—Y-Or P—n.v.	F—n.v. P—n.v.	sol. c. Benzol Or. sol. c. Pyridine Or.
62.	Cibanone Red 3G (Is actually an Orange)		Br	Or	n.v.	F—light Or P—st. light Y	F—Or P—Or	slt. sol. w. Benzol R. slt. sol. w. Pyridine R.
63.	Cibanone Red B		Vi-s	Or	Y-s	F—Or P—st. slt. Or	F—Or P—Or	slt. sol. w. Benzol Vi. slt. sol. w. Pyridine R.
64.	Cibanone Red 4B		Vi-s	Or	Or-R-s	F—Or P—st. str. Or	F—Or P—Or	slt. sol. w. Benzol Vi. slt. sol. w. Pyridine R.
65.	Ind. Bordeaux B	1143	Gr	Bl	dec. Y-Br	F—n.v. P—n.v.	F—n.v. P—n.v.	
66.	Indanthrene Pink B	Pro. 107	Vi-s	Or	Or-R	F—n.v. P—n.v.	F—n.v. P—n.v.	
67.	Ind. Brill. Pink BBL		Vi-Br	Or	Or	F—n.v. P—n.v.	F—n.v. P—n.v.	
68.	Indanthrene Violet BN	1163	dk Bl	Or-s	Or R	F—t. reddish P—st. Or-R-s	F—c.r. P—c.r.	sol. w. Benzol R with brill. Vi fluor. sol. w. Pyridine R.
69.	Indanthrene Violet FFBN (purified brand of Ind. Violet BN)	1163	G-Blk	Or-s	Or	F—Or P—st. Or	F—c.r. P—c.r.	sol. w. Benzol R with brill. Vi fluor. sol. w. Pyridine R.
70.	Ind. Red Violet RRK	1161	Vi Blk	Or R.	Or Br.	F—n.v. P—n.v.	F—n.v. P—n.v.	
71.	Ind. Navy Blue G Cibanone Navy Blue GA		More Bl.	R-Vi-s	Wine	F—n.v. or slt. Gr P—n.v.	F—t. Navy P—n.v.	sol. c. Benzol R Vi fluor sol. c. Pyridine R Vi fluor.

GROUP III

72.	Ind. Orange 6RTK	1137	n.v.	n.v.	dec. slt. Y-G-Y	F—n.v. P—n.v.	F—n.v. P—n.v.	sol. w. Pyridine Or.
73.	Ciba Orange R Algol Orange RF	1217	n.v. or slt. more Y.	dec.	Vi-Gr	F—Vi-s P—n.v.	F—Sc P—n.v.	

No.	Trade Name of Color	Colour Index No.	HYDROSULFITE Alkaline	HYDROSULFITE Acid	Sulfuric Acid	Nitric Acid	Stannous Chloride	REMARKS
74.	Cibanone Orange 3R		n.v.	Y-G	Cr	F—Cr P—st. str. Or	F—c.r. P—c.r.	sol. w. Benzol Or. sol. c. Pyridine Or.
75.	Cibanone Orange 6R		n.v.	Y-Br	Cr	F—Sc. P—st. str. Or	F—c.r. P—c.r.	sol. c. Benzol Or. sol. c. Pyridine Or.
76.	Algol Scarlet GG	1228	n.v.	n.v. lighter	Gr-Vi	F—n.v. or slt. more Vi P—st. slt. Sc	F—c.r. P—c.r.	
77.	Ciba Scarlet BG Algol Scarlet GGR	1218	n.v. or slt. more Y.	dec.	dk Vi	F—slt. more Vi P—n.v. or slt. Y	F—c.r. P—c.r.	
78.	Ciba Scarlet 2B Algol Scarlet 3B	Pro. 88	n.v. or slt. more Y	dec.	Vi	F—slt. more Vi P—n.v.	F—c.r. P—c.r.	
79.	Indanthrene Scarlet B (special Process type)		n.v. or more Y	c.r.	R	F—n.v. P—n.v.	F—n.v. P—n.v.	
80.	Ciba Red R	1229	n.v. or slt. more Vi.	n.v. or weaker.	slt. more Vi.	F—n.v. P—n.v.	F—n.v. P—n.v.	sol. w. Pyridine R.
81.	Ind. Brown GG		Br	Y	R-Vi then Br.	F—slt. dec. P—n.v.	F—n.v. P—n.v.	
82.	Ind. Brown RT Cibanone Brown G (not identical)	Pro. 104	n.v. or slt. more R.	Y	t. redder	F—slt. more R. P—st. slt. Y	F—R P—R	
83.	Ciba Brown 2R		n.v. or slt. more Y	t.Y	n.v. or Br Vi.	F—n.v. P—n.v.	F—n.v. P—n.v.	
84.	Cibanone Brown V	1171	n.v.	n.v.	Gr-G	F—t. Gr. P—st. str. Ol-Br	F—weaker Br-Vi P—Br-Vi	
85.	Ciba Heliotrope B	1205	Y-s	Y-s	Bl-Vi	F—n.v. more brill.) P—n.st.	F—n.v. P—n.v.	
86.	Ind. Corinth RK	1144	almost n.v.	Ol-Y	Ol-G	F—partially destroyed. P—n.st.	F—n.v. P—n.v.	
87.	Ind. Brill. Violet RK	1135	Br-Vi-s	Vi	R then quickly t. G.	F—R-s then G. P—st. Vi	F—Vi P—Bl	sol. w. Benzol Vi.
88.	Ciba Violet 6R Ind. Printing Purple R		Br-Or	Br-Vi-s	more R.	F—n.v. or more brill. P—n.v.	F—n.v. P—n.v.	
89.	Ciba Violet 2R		Y-s	dec.	more Bl or Bl-G	F—more brill. P—n.v.	F—n.v. P—n.v.	
90.	Ciba Violet RN		Y-s	dec.	more Bl or Bl G.	F—more brill. P—n.v.	F—n.v. P—n.v.	
91.	Ciba Violet B	1222	Y-s	dec.	Bl-Vi	F—more brill. P—n.v.	F—n.v. P—n.v.	
92.	Ind. Blue 5G	1111	n.v.	n.v.	int. G then light Ol.	F—emerald G P—st. str. G	F—int. Bl-G P—Bl-G	
93.	Ind. Brill. Blue RCL	1114	Vi-Bl	Vi	G	F—Or-s P—st. slt. Or	F—n.v. P—n.v.	
94.	Ind. Brill. Blue 3G (purified type of Ind. Blue 3G)	1109	n.v. or more Vi	Vi	G-Ol	F—Or with Y halo P—st. slt. Y	F—Bl P—Bl	
95.	Ciba Blue 2RH (Hydron Blue R)	969	Y-G-s	Y	more G.	F—more G then Ol-s. P—st. slt. Bl-G	F—weaker Y-G-s P—G-s	
96.	Ciba Blue RH		Y-G-s	Y	more G.	F—more G P—st. slt. Bl	F—t. Y-G-s P—G-s	
97.	Cibanone Blue 2G		n.v.	n.v.	G-Ol.	F—lemon Y P—st. slt.	F—c.r. P—c,r.	
98.	Indanthrene Blue 3G	1109	n.v. or slt. more Vi.	Vi	Ol-G-s-lt.	F—int. Y-Or P—st. Y-Or	F—Bl P—Bl	

No.	Trade Name of Color	Colour Index No.	HYDROSULFITE Alkaline	HYDROSULFITE Acid	Sulfuric Acid	Nitric Acid	Stannous Chloride	REMARKS
99.	Cibanone Green GC		Vi-Gr	Or	Ol	F—Vi then R P—st. Vi	F—dec. then c.r. slowly. P—st. appears slowly.	
100.	Indanthrene Green 2B	1116	Vi-Bl	Gr	int. G.	F—Bl-G that goes almost entirely on the (filter paper) P—Bl-G	F—G P—G	
	GROUP IV							
101.	Ciba Pink BG Ind. Printing Red 3B	Pro. 45	n.v. or slt. more Y.	n.v.	n.v.	F—n.v. P—n.v.	F—n.v. P—n.v.	
102.	Ind. Brill. Pink 3B		R-Sc	n.v.	Rubine	F—slt. more Y. P—st. slt. Y.	F—n.v. P—n.v.	
103.	Ind. Brill. Pink R (Hydron Pink FF)	Pro. 91	n.v. or slt. more Y.	n.v.	n.v. t.G on heating.	F—n.v. P—n.v.	F—n.v. P—n.v.	
104.	Ind. Brill. Pink B Ciba Brill. Pink B	Pro. 90	n.v.	n.v.	n.v.	F—n.v. P—n.v.	F—n.v. P—n.v.	
105.	Ciba Red G	1226	n.v. or slt. more Or.	n.v.	n.v. or more Brownish.	F—n.v. or slt. more Vi. P—n.st.	F—n.v. P—n.v.	sol. w. Pyridine R.
106.	Ciba Red 3B Ind. Red Violet RH	1212	Br-Y-s	c.r.	n.v. or slt. more R.	F—n.v. P—n.st.	F—n.v. P—n.v.	t. Y in Reaction I when heated.
107.	Ind. Printing Violet 6R		Br-Y-s	c.r.	n.v. or slt. more R.	F—n.v. P—n.st.	F—n.v. P—n.v.	
108.	Cibanone Red G		n.v. or slt. more Br.	slt. more Y	n.v.	F—t. Yellower. P—st. str. Y-Or.	F—Or P—Or	
109.	Ind. Rubine R	Pro. 108	n.v. or Vi-s	n.v.	Gold	F—slt. more Or. P—st. Or	F—c.r. P—c.r.	
110.	Ciba Bordeaux 2R		n.v.	n.v.	n.v.	F—n.v. P—n.v.	F—n.v. P—n.v.	
111.	Ciba Bordeaux B	1208	Y-s	c.r.	n.v.	F—n.v. P—n.v.	F—n.v. P—n.v.	
112.	Cibanone Brown B		n.v.	n.v.	n.v.	F—n.v. P—n.v.	F—n.v. P—n.v.	
113.	Ciba Brown G Ind. Brown RRD	Pro. 105	n.v. or slt. more Y.	n.v.	n.v.	F—n.v. P—n.v.	F—n.v. P—n.v.	sol. w. Pyridine Br Vi.
114.	Indanthrene Brown GR	1149	n.v.	G-Ol-lt.	n.v.	F—n.v. P—n.v.	F—n.v. P—n.v.	
115.	Indanthrene Brown BR	Pro. 102	slt. more Or.	Y-G-s	n.v.	F—n.v. P—n.v.	F—n.v. P—n.v.	
116.	Indanthrene Brown FFR		Vi-s or R.	Y-Or	Cherry R.	F—slt. more R. P—n. st.	F—c.r. P—c.r.	
117.	Indanthrene Khaki 2G	Pro. 106	Vi-Br	G	n.v.	F—n.v. P—n.v.	F—n.v. P—n.v.	
118.	Ind. Red Violet RRN		n.v. or slt. more R.	c.r.	Rubine	F—n.v. P—n.v.	F—n.v. P—n.v.	
119.	Ind. Brill. Violet BBK	1134	Br-Vi-s	Vi	R-Vi then G-Ol.	F—R Vi P—n. st.	F—c.r. P—c.r.	sol. w. Pyridine, slt. fluor. colored yarn t. blue in soda-ash boil.
120.	Cibanone Navy Blue RA		n.v.	n.v.	Vi-s	F—G-Bl-s P—st. slt. G	F—c.r. P—c.r.	
121.	Indanthrene Blue 8GK		Vi	more yellowish	G-changes quickly to lt. Br-R-s.	F—t. Or-s P—st. str. Br-Y.	F—lt. Vi P—lt. Vi	
122.	Indanthrene Blue BC	1114	n.v.	n.v.	G-Ol then Br-st. liquid R Br.	F—G-Ol very pale P—pale Ol	F—G-Ol P—Bl	
123.	Indanthrene Blue RK	1108	n.. or slt. more Br.	n.v.	Y-s	F—Y-s P—st. str. Y-s	F—Gr-Bl P—Bl	

No.	Trade Name of Color	Colour Index No.	HYDROSULFITE Alkaline	HYDROSULFITE Acid	Sulfuric Acid	Nitric Acid	Stannous Chloride	REMARKS
124.	Indanthrene Blue RC		n.v.	G-Bl	Y-G-s or Ol.	F—Gr-Br P—st. Gr-Br Ol	F—Gr-Bl P—Gr-Bl	slt. sol. w. Pyridine, fluor. The HNO_3 reaction is very characteristic Gr-Br.
125.	Indanthrene Blue RS Cibanone Blue RS	1106	n.v. or slt. more G.	n.v.	Ol then quickly t. Y-s.	F—Y P—st. str. Y	F—int. Bl P—Bl	
126.	Ind. Brill. Blue R (purified type of No. 125)	1106	G then Bl	n.v.	G then quickly t. Ol. lt.	F—int. Y P—st. str. Y	F—int. Bl. P—Bl	
127.	Indanthrene Blue GCD	1113	n.v.	n.v.	Ol then quickly t. Y-s.	F—Y-G-s P—st. Y-G	F—sky Bl. P—sky Bl.	
128.	Indanthrene Blue GCDN (purified type of Ind. Blue GCD)	1113	n.v.	n.v.	Ol then quickly t. Y-s.	F—Y-G-s P—st. Y-G	F—sky Bl. P—sky Bl.	
129.	Indanthrene Blue BCS Cibanone Blue GLN	1114	n.v.	n.v.	G-Ol then Br st. liquid R Br.	F—G-Ol very pale. P—pale Ol.	F—G-Ol P—Bl	
130.	Indanthrene Blue RSN		n.v. or slt. more G.	n.v.	Br	F—Y slt. G-s P—st. str. Y. slt. G.	F—c.r. P—c.r.	
131.	Indanthrene Blue GC Cibanone Blue GL	1115	n.v. or slt. more G.	n.v.	lt. Ol then quickly t. Y-s.	F—lt. Y-G-s P—st. Y-G-s	F—G P—BL	
132.	Indanthrene Blue GCN (purified brand of Ind. Blue GC)	1115	n.v. or slt. more G.	n.v.	G-Ol then quickly t. Y-s.	F—lt. Y-G-s P—Y-s	F—G P—Bl	
133.	Indanthrene Blue 3GT		n.v.	n.v.	Ol then quickly t. lt. Y.	F—Y-G-s P—st. Br-R	F—G P—Bl	The HNO_3 reaction is very characteristic of this blue.
134.	Ind. Blue Green B	1173	Bl	R-Vi	dec. to G-Ol.	F—Gr G P—n.st.	F—c.r. P—n.v.	
135.	Ind. Blue Green FFB Cibanone Blue 3GF	1173	Bl	R-Vi	t. G-Ol-s	F—Gr-Br P—n.st.	F—c.r. P—c.r.	
136.	Ind. Dark Blue BO-BOA (Violanthrone)	1099	slt. more Vi.	Vi-R-s	n.v. or Vi-Gr.	F—Vi-Gr P—n.v. or slt. st.	F—n.v. P—Bl-Vi	R Bl fluor. in Benzol.
137.	Cibanone Dark Blue MB-MBA		n.v. or slt. Vi	Vi-R-s	n.v. or Gr.	F—Blk.-s P—n.v. or st. slt.Vi.	F—Bl-Vi P—Bl-Vi	R Bl fluor. in Benzol. Hard to differentiate from above.
138.	Indanthrene Green G		Vi-Bl	Gr-Vi	Y-Gr	F—Y P—st. str. Y.	F—G P—Bl G.	
139.	Indanthrene Green 2G		Vi-Bl	n.v.	Y-Ol then lt. Y.	F—int. Y. P—st. str. Y	F—Vi-G P—G-R-s	Mixture of Blue GCD and Algol Yellow GC.
140.	Indanthrene Green GT		Bl-G	Gr	Bottle G.	F—dk. G with Or halo. P—st. G	F—n.v. P—n.v.	
141.	Cibanone Green B	1174	int. Bl	R-Vi	Vi-s	F—Gr-G P—st. slt. Gr G.	F—Bl-s P—Bl-s	
142.	Cibanone Green G (similar to the 'B' brand)		Bl	R-Vi	Br-Vi	F—n.v. P—st. slt. G	F—Bl-G P—Bl-G	
143.	Ind. Brill. Green B (Jade Green)	1101	Bl	R-Vi	R-Or-s	F—Bl-Vi with Y halo. P—st. slt. Bl Vi	F—n.v. P—n.v.	
144.	Ind. Brill. Green FFB	1101 (purified)	Bl	R-Vi	R-Or-s	F—Bl-Vi with Y halo. P—st. slt. Bl Vi	F—n.v. P—n.v.	
145.	Ind. Brill. Green GG		Bl	R-Vi	R-Br	F—Gr G P—n.v.	F—G-s P—n.v.	Mixture of Brilliant Green B and Algol Yellow GC.

No.	Trade Name of Color	Colour Index No.	HYDROSULFITE Alkaline	HYDROSULFITE Acid	Sulfuric Acid	Nitric Acid	Stannous Chloride	REMARKS
146.	Ind. Brill. Green 4G		Bl	R-Vi	Y then Or-s.	F—Y-G P—n.v.	F—G P—n.v.	Mixture of Brilliant Green B and Algol Yellow GC.
147.	Ind. Olive Green B		dk. Bl	Bl	brill. G	F—Br Gr P—n.v.	F—n.v. P—n.v.	
148.	Indanthrene Olive R	1150	dk. Br	Y	Vi-R then Br.	F—R-Or P—st. slt. Or	F—n.v. P—n.v.	
149.	Indanthrene Olive 3G		Br. Y	Y	Gr-Or	F—Or P—st. Or	F—n.v. P—n.v.	
150.	Cibanone Olive B	1175	Bl-G-s	Vi. R	Br Vi	F—t. greenish P—st. slt. G	F—Gr Bl P—Gr Bl	
151.	Cibanone Olive G (similar to Cibanone Olive B)		G-Bl	Brick	lt. Br.	F—Ol Y-s P—st. slt. Ol-Y-s	F—Gr Vi P—Gr Vi	
152.	Ciba Gray G	1220	Ol	c.r.	Ol	F—t. Vi P—st. Vi	F—t. slowly Bl P—t. slowly Bl	Mixture.
153.	Ciba Gray B (similar to Ciba Gray G)		Ol	c.r.	Ol or n.v.	F—Vi-R P—st. Vi R	F—t. very slowly Bl. P—t. slowly Bl.	Mixture.
154.	Cibanone Gray GN		Vi Bl	R Vi	Ol-G then int. Ol.	F—almost completely dec. P—st. slt. Y	F—Gr Bl P—lt. Gr Bl	Mixture.
155.	Cibanone Olive 2G		Bl-G	c.r.	Ol G	F—Ol P—st. slt. Tan.	F—Vi-Br-s P—Redder	
156.	Cibanone Gray BN		Vi Bl	R-Vi	G-Ol	F—almost completely dec. P—st. slt. Gr	F—slt. Vi P—slt. Bl	
157.	Cibanone Gray RA		Vi Bl	R-Vi	Ol-Y	F—dec. P—st. slt. Gr	F—n.v. P—n.v.	
158.	Cibanone Gray RN		Vi Bl	R Vi	Ol-Y	F—str. dec. P—st. slt. Gr	F—n.v. P—n.v.	
159.	Indanthrene Gray K	1145	n.v. or slt. more G	n.v.	Ol-Y-s	F—slt. more Vi P—st. slt. Br	F—Gr P—Gr	
160.	Indanthrene Gray RRH		Bl	Gr	Gr Br-s	F—Br-when squeezed between paper more Vi. P—st. Br	F—Gr P—sky Bl	
161.	Indanthrene Gray 3B		Vi	Wine	Gr-Vi	F—n.v. or slt. more Gr. P—n.v.	F—n.v. P—n.v.	
162.	Indanthrene Gray 6B	1213	Y-G-s	dec.	Vi-R	F—Vi R P—st. Vi-R	F—Vi R P—Vi R	
163.	Indanthrene Gray BG		Redder	slt. more Y.	Ol-Y-s	F—Corinth to R-Br. P—Corinth to R-Br.	F—more Bl P—more Y	
164.	Indanthrene Gray GK Algol Gray B		Gr	G-Gr	Y-Ol	F—Gr slt. more Vi P—st. Vi	F—n.v. P—n.v.	
165.	Indanthrene Gray BTR (similar to Ind. Gray RRH)		Bl	Gr-Vi	t. Y-s	F—Br very Or P—st. str. Br Or	F—Gr P—Bl	
166.	Indanthrene Gray M		Gr-G	Gr-Vi	G	F—R Gr P—Bl	F—n.v. P—pale G	
167.	Indanthrene Black 2B Cibanone Black BB	1102	Blk. Bl.	Vi-R-s	Blk Vi	F—Gr Vi P—slt. st.	F—Gr Vi P—Gr Vi	Hypochlorite development type.

No.	Trade Name of Color	Colour Index No.	HYDROSULFITE Alkaline	HYDROSULFITE Acid	Sulfuric Acid	Nitric Acid	Stannous Chloride	REMARKS
168.	Indanthrene Black BGA	1102	Blk Bl	Vi-R-s	Blk Vi	F—Gr Blk slt. Vi P—n.st.	F—Gr Blk P—Gr Blk	Hypochlorite development type.
169.	Ind. Direct Black RB		Blk Bl Vi	Vi-R-s	Blk Vi	F—n.v. P—slt. st. Gr	F—n.v. P—dk. G	
170.	Ind. Printing Black BG		Br Blk	Br-Vi-s	Bl	F—n.v. P—st. int. Y Br	F—n.v. P—dk. G	Mixture of Brill. Indigo, Yellow and Orange.
171.	Ind. Printing Black BR		Bl	Br	Vi Blk	F—n.v. P—st. Br	F—n.v. P—dk. G	Mixture principally of Ind. Dk. Blue BO. Do not confuse with any Helindone or Thioindigo types which have Y Leuco compounds.
172.	Cibanone Black BA		Vi	Vi R	Gr R-s	F—n.v. P—st. slt.	F—n.v. P—n.v.	Mixture.
173.	Cibanone Black BF		Vi	Vi R	Gr Ol	F—str. dec. P—st. Gr	F—Vi-s P—n.v.	Mixture.
174.	Cibanone Black EA		Vi	Vi R	Gr Ol	F—str. dec. P—st. Gr	F—n.v. P—n.v.	Mixture.
175.	Cibanone Black EF		Vi	Vi R	Gr Ol	F—str. dec. P—st. Gr	F—n.v. P—n.v.	Mixture.
176.	Cibanone Black 2G	1172	Vi-s	Vi R-s	Br Blk	F—n.v. P—R Br	F—slt. Ol P—slt. Y	

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Physical and Chemical Textile Testing - III

JOHN H. SKINKLE*

PART I—PHYSICAL TESTING

(Continued from September 20, 1937 issue)

CHAPTER 4—YARN TESTING

Counts and Denier

In determining the relative sizes of yarns, two systems immediately suggest themselves—giving the diameter of the yarn, and giving the weight-length ratio of the yarn. The diameter would be the more direct method of measurement, but a little consideration will show that it is impractical for several reasons; for one reason, the edge of the yarn is not always sharp but very often fuzzy and indistinct; for another reason, any instrument used would compress the yarn so that almost any value might result, depending upon the force applied. Diameter of hard yarns may be measured by a gauge similar to that discussed later for determining the thickness of cloth but the re-

*Department of Chemistry, Lowell Textile Institute, Lowell, Massachusetts.

sults are of questionable value; the diameters may be measured also by the microscope but even here the results vary depending upon the tension used on the yarn. Proponents of the yarn diameter measurement point out that it gives a better idea of the uniformity of the yarn but the same results may be obtained by weight-length rations on short lengths of yarn. Diameter measurements, then, are seldom carried out and weight-length ratios are the usual methods of expressing the size of yarns.

Two systems of expressing weight-length ratios are in use:

1. Counts or number—the number of units of length in a unit of weight (used on all spun yarns).
2. Denier—the number of units of weight in a unit of length (used on all continuous filament yarns).

In the counts system, the unit of length is a "hank" or standard skein, and the unit of weight is (in the United States and Great Britain) the pound, in France is 500 grams, and in the rest of Europe is the kilogram. For our purpose, we may define the counts then as the number of hanks in a pound. The hank varies with the branch of the textile industry and also somewhat with geographical location. In cotton mills, for example, the standard hank is 840 yards; in worsted mills, the standard hank is 560 yards. Metric counts is the number of hanks of 1000 meters in one kilogram. French counts is the number of hanks of 1000 meters in 500 grams. Because of the confusion of using all these systems, it has recently been proposed by the A.S.T.M. that a universal system called the "Typp" system be used for all fibers. The Typp system is based on a standard hank of 1000 yards as indicated by the name which consists of the initial letters of the phrase "Thousands of Yards Per Pound." The length of the standard hank for various systems is given in Table VII.

TABLE VII
Standard Hanks of Yarn

Standard Weight = One Pound	
Typp system	1000 yards
Cotton, spun silk, spun rayon	840 yards
Worsted	560 yards
Woolen, cut system	300 yards
Woolen, run system	1600 yards
Flax, hemp, jute	300 yards
Standard Weight = One Kilogram	
Metric system	1000 meters
Standard Weight = 500 Grams	
French system	1000 meters
Denier = deniers (0.05 gram) per 450 meters	
= grams per 9000 meters	
= grains per 638 yards	
= pounds per 4,464,528 yards	

The denier system was once in considerable confusion because different localities adopted different units of weight and length but, in this country at any rate, the adoption of the so-called "legal denier" has eliminated the confusion. The denier of a yarn is now expressed as the number of 0.05 gram weights (deniers) of a standard skein of 450 meters; another way of expressing it is the number of grams in a skein of 9000 meters. In English units, this is equal to the number of grains in 638 yards or the number of pounds in 4,464,528 yards.

Fig. 14—Yarn Reel

The length of the yarn is obtained by use of a yarn reel as illustrated in Figure 14. This consists essentially of six arms of such a length that the perimeter of the hexagon formed by wrapping the yarn around the arms is one yard, 1½ yards, or 112.5 centimeters. The reel is operated by a crank or in the most modern type is operated at constant speed by a motor. A revolution counter calibrated in yards is attached to measure the total length of the yarn reeled off and a bell is so connected as to give a warning ring just before a complete revolution of the counter. The yarn may be reeled off a cone, a spool, a bobbin, or a skein as shown in Figure 15, passing over a pig-tail which is used to obtain an approximately constant tension; the pig-tails are moved sideways to spread the yarn out evenly on the reel. In order to obtain accurate results three conditions are necessary:

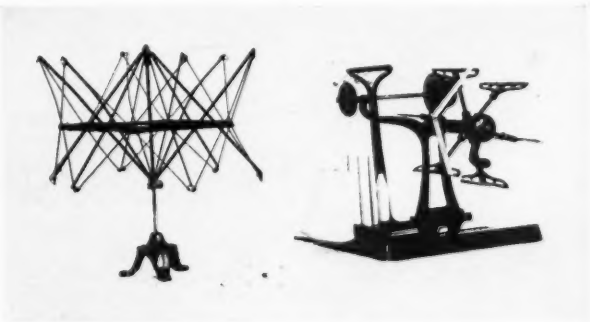

Fig. 15—Skein Holder and Yarn Reel

1. The yarn must be spread out on the reel so that each revolution will reel off exactly the same length of yarn.

2. The tension must be constant and neither too much nor too little.
3. The speed of the reel must be constant.

In order that these conditions shall be met, the A.S.T.M. has proposed the following standard conditions for use of the reel:

1. A reel shall be used which spreads the yarn out on the reel, and not more than 120 yards shall be reeled off in any one skein.
2. The tension shall consist of one full turn around the pigtail (this may be modified for loosely-twisted yarns).
3. Standard speeds are specified for the reels as follows:
   a. Cotton yarns taken from bobbins or cones = 100 to 300 revolutions per minute
   b. Cotton yarns taken from parallel tubes = 20 to 30 revolutions per minute
   c. Rayon yarns taken from skeins = 100 to 150 revolutions per minute
   d. Rayon yarns taken from spools, cops, tubes, or cones = 200 to 300 revolutions per minute
   e. Woolen and worsted yarns = no standard speed given

The 1½ yard reel is now the most frequently used, the one yard reel being largely displaced. For silk or rayon the 112.5 centimeter reel is used because 200 turns will give a skein of 225 meters which is an even subdivision (1/40) of 9000 meters, the standard hank. The 1½ yard reel may however be used to measure the denier of silk or rayon by using the proper conversion factor. Shorter lengths of yarn may be used for counts or denier determinations if measured under standard tension, which is enough to straighten but not stretch the yarn (this will be discussed later under crimp).

The reel may also be used to check the total length of yarn on a package by passing the yarn three times around the reel and winding it up on a drum until the whole package is unreeled. The total yardage of the package is then indicated by the number of revolutions of the reel.

Weighings of the yarn may be made by:

1. Grain scales at room conditions.
2. Analytical balance at room conditions.
3. Special quadrant scales at room conditions—usually direct reading.
4. Torsion balance and drying oven.
5. Analytical balance and drying oven.

Weighing oven-dry in the oven by means of a balance mounted on the oven is the most accurate method of getting the true weight, but it is more convenient to weigh out in the room, provided that the room is maintained at standard conditions of temperature and relative humidity.

The grain scales (Figure 16) are in general use for determining the weight of skeins of yarn at room conditions, these are calibrated in grains and a simple calculation gives the counts of the yarn if the standard skein

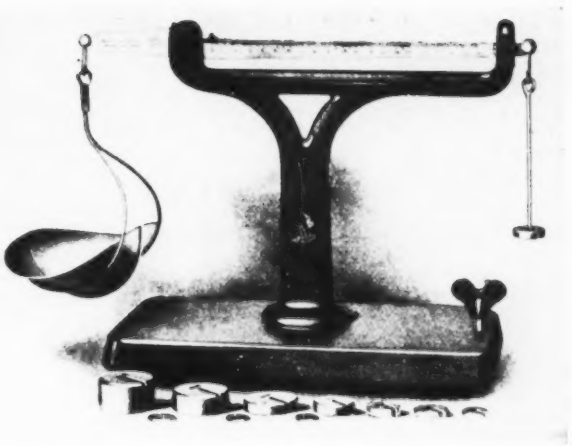

Fig. 16—Grain Yarn Scales

is weighed. The analytical balance gives more accuracy than is usually necessary and is valuable principally in determining counts or denier from small lengths of yarn, as unraveled from a cloth for example. The special quadrant scales are usually direct reading provided that a certain definite length of yarn is taken; these are for plant use only, they are not accurate enough for precise determinations.

TABLE VIII
English and Metric Equivalents

1 yard	=	36 inches	=	0.9144 meters
1 meter	=	39.37 inches	=	1.094 yards
1 pound	=	7000 grains	=	453.6 grams
1 ounce	=	437.5 grains	=	28.35 grams
1 gram	=	15.43 grains		

A more accurate method is to weigh the skeins when oven-dry. The so-called "conditioning ovens" usually supplied to the textile industry consist of an oven with a torsion balance accurate to a centigram or to 1/10 grain mounted on it. These are sufficiently accurate for counts determinations but a combined oven and analytical balance is even more accurate besides being useful in getting counts of small pieces of yarn and for various chemical textile tests.

The formulae for calculating counts and denier from length and weight determinations are as follows:

$$N = \frac{L}{W} \times \frac{7000}{H}$$

Where N = counts or number
L = length in yards
W = weight at standard regain in grains
H = length of standard hank in yards (Table VII)

$$D = \frac{9000 \times W'}{L'} \quad \text{or} \quad D = \frac{638 \times W}{L}$$

Where D = legal denier
L' = length in meters
W' = weight at standard regain in grams

The use of these formulae may best be shown by illustrative examples. Suppose that a 120 yard skein weighs 25 grains at standard conditions, then

$$N = \frac{L}{W} \times \frac{7000}{H} = \frac{120}{25} \times \frac{7000}{840} = 40$$

The yarn counts is expressed as a figure with ('s) sign, and preferably with some phrase which will give the system used. The above result would be expressed as 40's cotton count.

A dry spun worsted skein of 80 yards weighs 50 grains when oven-dried, what is the worsted count? Here, W is not 50 grains but 50 grains plus 15.0% (Table IV) or W = 50 x 1.15 = 57.5 grains.

$$N = \frac{80}{57.5} \times \frac{7000}{560} = 17.4\text{'s worsted}$$

A woolen yarn skein of 100 yards weighs 3.25 grams when oven-dried, what is the Typp number? Here, we must convert from grams to grains (Table VIII) and then add the standard regain (Table IV).

$$W = 3.25 \times 15.43 \times 1.13 = 56.6 \text{ grains}$$

$$N = \frac{100}{56.6} \times \frac{7000}{1000} = 12.3\text{'s Typp}$$

A viscose rayon skein of 225 meters weighs 2.30 grams when oven-dry, what is the denier?

$$W' = 2.30 \times 1.11 = 2.55 \text{ grams}$$

$$D = \frac{9000 \times 2.55}{225} = 102\text{d}$$

Here, the denier is shown by adding the (d) after the figure.

A silk skein of 120 yards weighs 2.75 grams when oven-dry, what is the denier? Here we have one measurement in English units and one in metric units; we must convert one to the other, so the calculation may be done in one of two ways:

$$L' = 120 \times 0.914 = 109.5 \text{ meters (Table VIII)}$$

$$W' = 2.75 \times 1.11 = 3.05 \text{ grams}$$

$$D = \frac{9000 \times W'}{L'} = \frac{9000 \times 3.05}{109.5} = 250\text{d}$$

or $L = 120$ yards

$$W = 2.75 \times 15.4 \times 1.11 = 47.0 \text{ grains}$$

$$D = \frac{638 \times W}{L} = \frac{638 \times 47.0}{120} = 250\text{d}$$

These examples are elementary ones, only; more complicated examples will be given later when the effect of combining two or more yarns will be taken up.

The A.S.T.M. has specified tolerances on counts and deniers. Tolerances are the amounts above and below the specified value which the average of a lot of yarn may vary and still be acceptable. These tolerances are given in Table IX.

REFERENCES:

[1]Haven, G. B. Mechanical Fabrics. John Wiley & Sons, Inc., New York (1932).

[2]Saxl, I. J. Rayon and Synthetic Yarn Handbook. Rayon Publishing Corp., New York (1936).

[3]A.S.T.M. Standards on Textile Materials. A.S.T.M., Philadelphia (1936).

TABLE IX
Yarn and Fabric Tolerances

Counts and Denier of Yarns	
Cotton	3.0%
Spun rayon	5.0
Woolen, coarser than No. 3 Typp	10.0
No. 3 to No. 6 Typp	7.5
No. 6 and finer	5.0
plied yarns	5.0
Worsted, coarser than No. 12 Typp	5.0
No. 12 to No. 17	3.5
No. 17 to No. 23	3.0
No. 23 and finer	2.5
plied yarns	2.5
Rayon, singles, 150d or coarser	4.0
singles, finer than 150d	5.0
plied, 150d or coarser	8.0
plied, finer than 150d	10.0
Twist of Yarns	
Cotton	5.0%
Woolen and worsted	7.5
Rayon, under 7½ TPI	25
7½ to 10 TPI	25
over 10 TPI	5
Knit Goods	
Wales per inch, courses per inch	—5% to +5%
Cloth	
Number of yarns per inch, warp	—3% to +4%
filling	—5% to +7%
Weight, ounces per square yard	—4% to +6%

Plies and Filaments

Under this heading, we will consider the number of units which go to make up a yarn. When a rayon is spun, a liquid is forced through a die containing a certain number of holes; similarly when a real silk yarn is made, it is composed of a certain number of cocoons which are unwrapped and combined to form the silk yarn. It is obvious that if we have two yarns of the same denier but one contains more filaments than the second, then the first yarn will be more pliable and flexible and softer than the second. In rayon yarns then, it is customary to give the number of filaments as well as the denier; thus a 150 denier yarn composed of 40 filaments would be given as 150d 40f or as 150/40. The usual number of filaments in a rayon yarn are 16, 18, 24, 36, 40, 42, 60, 66, 88, 100 but the two most common numbers are 40 and 60 filaments.

If the filaments are fairly coarse (3-4 denier per filament or more) the easiest way to count the filaments is to cut a piece about an inch long, untwist the yarn if any appreciable twist is present and withdraw the filaments from the bundle one at a time by means of a pair of tweezers, counting the filaments as they are withdrawn. If the filaments are fine but not too numerous, a mount may be made and the filaments counted through a binocular microscope. If the filaments are fine and numerous, it is safest to stain the rayon, make a wax candle, cut cross-sections and count the number of cross-sections in the mount, using a microscope.

(Continued on page 608)

PROCEEDINGS OF THE
American Association of Textile Chemists and Colorists

OCTOBER 4, 1937

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Philadelphia Textile School Student Section
Wayne F. Fry, Chairman; Robert Roecker, Secretary.

Members should notify **Secretary** immediately of all address changes

Calendar of Coming Events

Meeting, New York Section, Swiss Chalet, Rochelle Park, N. J., October 22, 1937.

Fall Meeting, Southeastern Section, Colonial Hotel, La Grange, Georgia, Oct. 9, 1937.

Fall Meeting, Piedmont Section, Carolina Hotel, Pinehurst, N. C. November 6, 1937.

Annual Meeting and Convention, December 3 and 4, 1937, Bellevue-Stratford Hotel, Philadelphia, Pa.

Report of the Nominating Committee

PRESIDENT CADY and Vice President Bertolet, having declined to be candidates for re-election, and councilors Draves and Herrmann retiring in accordance with the Constitution, the Voting Members of the Nominating Committee, by majority vote or better in each case, have signified to the Secretary the following as their candidates for the election of 1937.

For: President—Alban Eavenson
Vice President—Duncan Ferguson
Vice President—Arthur R. Thompson, Jr.
Treasurer—William R. Moorhouse
Councilor-at large—Walter M. Scott
Councilor-at-large—Harold DeWitt Smith

A counter nomination for any office, signed by at least ten Active members and delivered to the secretary on or before November 1st, will appear on the ballot in accordance with article VIII of the Constitution.

The voting Members of the Committee are:

J. L. Crist representing Piedmont Section
G. H. Dubois representing South Central Section
J. F. Feit representing Mid West Section
A. K. Haynes representing Southeastern Section
H. F. Herrmann representing New York Section
W. R. Moorhouse representing Northern New England Section
C. A. Seibert representing Philadelphia Section
Ben Verity representing Rhode Island Section

ANNUAL MEETING AND CONVENTION

DECEMBER 3rd and 4th

PHILADELPHIA, PA.

HEADQUARTERS

BELLEVUE-STRATFORD HOTEL

Under the auspices of

Philadelphia Section, A.A.T.C.C.

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the secretary or the American Dyestuff Reporter any vacancies which may occur in their businesses.—H. C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive.

NOTE: PERSONS WHO HAVE OBTAINED EMPLOYMENT SHOULD NOTIFY THE SECRETARY OR THE AMERICAN DYESTUFF REPORTER AT ONCE.

Prospective employers may file vacancies either with the secretary or the American Dyestuff Reporter.

A-1

Education—B.T.C., Lowell Textile Institute.
Experience—Two years as chief chemist in cotton mill. Experienced on direct, vats, naphthols, sulfur, basic and developed colors. Two years' experience in protein, fat fiber and mineral control in grains and animal feedstuffs. Age 28.

A-2

Education—Polytechnic Institute, two years; graduate Industrial Chemical Engineering, Pratt Institute, 1934.
Experience—3½ years experience with sulfonated oils, soaps and textile detergents. Has experience as control and analytical chemist. Familiar with production and management of manufacturing.
Age 27; married; references.

A-B-1

Education—Graduate chemist and colorist from a leading textile institute. Speaks French fluently. High standing at school. Awarded 1st prize in chemistry. Member of honor society.
Experience—Knowledge of most processes of textile manufacturing and some experience in woolen and worsted piece and stock dyeing and color matching. Presently employed in other department but wishes to get into laboratory or dyehouse.

A-B-5

Education—Graduate of the University of Lausanne, Switzerland. Doctor's degree in Chemistry. Knowledge of French and German.
Experience—Eleven years with large bleaching, dyeing, printing and finishing plant as assistant Chemist and then Chemist in charge of the Laboratory. Experience in dyeing and printing cotton and rayon fabrics; research and analytical work. Woman.

A-B-7

Education—Evening school in textile dyeing and chemistry.
Experience—Dyehouse laboratory for 2 years. Foreman dyer and finisher on hosiery for 9 years. Experience on ribbons also vat dyes on rayon and silk skeins. 2 years assistant to superintendent. Desires position either in demonstrating and sales or dyer. Age 31; married.

A-B-C-2

Education—Graduate of Lewis Institute of Engineering of Chicago and graduate of Philadelphia Textile School (Chemistry and Dyeing department).
Experience—Has had extensive experience as assistant chemist and colorist in silk printing, dyeing and finishing; also dyeing raw stock wool; and dyeing and finishing cotton and rayon. Age 30; married; references.

A-B-C-4

Education—Educated abroad.
Experience—Twenty years experience in the textile field as Bleacher, dyer, finisher and chemist. 16 years in charge of dyestuff laboratory of large dyeing plant, 4 years as chief chemist with large bleachery. Has tested dyestuffs, and chemicals used in the textile field and has manufactured soaps and textile specialties. Has handled all textile fibers; bleaching, printing, dyeing and finishing same. Has done pigment and lacquer printing, waterproofing and fireproofing. Reason for leaving last position was due to business conditions.
Age 41; married.

A-B-C-5

Education—Graduate Chemist from a leading textile school. Graduate of business college.
Experience—11 years plant work which includes: 5 years laboratory, 3 years superintending Sanforizing and finishing, 2 years color shop, 1 year assistant colorist and supervisor of entire printing department. Will go anywhere.
Age 30, married.

A-C-1

Education—B. S. Degree, Brooklyn Polytechnic Inst.
Experience—4 years chemist in large silk processing company. Foreman of silk weighting department. Boiling off and dye testing experience.

B-3

Experience—Foreman piece dyer for the past 21 years. Can dye the following: celanese, rayon, cotton backs, wool, silk and mixed fabrics. Has knowledge of finishing and laboratory work.

B-4

Experience—Foreman dyer in charge of ribbon dyeing for 20 years. Experienced on silk, cotton, rayon, acetate yarn. Age 41; will go anywhere.

B-5

Education—High School and Textile School Graduate.
Experience—Twelve years overseer of dyeing on directs, vats, naphthols, sulfur, basic and developed colors. Also experienced bleacher. Age 40; married; references.

B-6

Education—Textile School Graduate.
Experience—Former instructor in chemistry and dyeing. Twelve years' experience as overseer of dyeing of vats, naphthols, developed, indigosols, sulfur and direct colors on piece goods. Age 35; excellent references.

B-C-1

Experience—8 years experience as boss dyer and finisher on transparent velvets, frieze, auto and furniture mohairs and mixtures, cloakings and knitted astrachan, rubberized auto plushes and other knitted goods. Will take position in either department preferably dyeing. Will go anywhere.
Age 32; married; two children.

B-F-1

Experience—As executive had charge of the dyeing of ribbons and piece goods for 6 years; spun silk yarn, fast and resisted dyeing for 8 years; hosiery for 12 years. Has been quite successful in all three of these mills. Age 50 married. Will go anywhere.

F-1

Education—Graduate of School of Textiles, Saxony (1925). Graduate of School of Commerce of University of Berlin (1928).
Experience—Worked in various departments of textile mills as worker, later as a supervisor. Familiar with the production, calculation and management of manufacturing. Thirty years old; unmarried.

AMERICAN
DYESTUFF REPORTER

A. P. HOWES
Publisher

LOUIS A. OLNEY, Sc.D.
Professor of Chemistry and Dyeing, Lowell Textile Institute
Directing Editor

NORMAN A. JOHNSON
Managing Editor

MYRON DREW REESER
Advertising Manager

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ADVANTAGES OF COMPETITION

IN these troublous times it is often said that the competitive system has broken down, and that some other system must be substituted. The competitive system has its imperfections, of course, but it has so many advantages that we should not lightly discard it unless we have reasonable assurance that some other system would work better.

The advantages of competition may be briefly listed.

Competition serves as a means of social selection; it discharges the function of determining the place that each person shall occupy in the economic order. If "all the world's a stage," competition is a device for assigning the parts to the players. The process of selection works for institutions, of course, as well as for individuals.

Competition serves also as a regulator of prices. The competition of producers to sell tends to keep prices down, and the competition of consumers to buy tends to keep prices up. Competition among the sellers may be relied upon to protect consumers from exploitation; competition among the buyers may be relied upon to assure producers adequate profits.

Competition determines the amount of labor, capital, and land to be used in each industry, and by each producer in the industry. If there exists a state of free enterprise, in which manufacturers are allowed to compete with one another for the agents of production, labor, capital, and land will be employed as a rule to produce the goods that the people demand, thereby promoting the public welfare.

Competition is a method of fixing the rewards of the several agents of production—labor, capital, land, and enterprise. Under competition, moreover, there are forces at work that tend to give each of the agents of production a reward roughly in accordance with its economic worth. These forces work imperfectly, to be sure. Thus it would be absurd to maintain that in a competitive regime all groups of laborers are paid exactly what they are worth. It would be absurd, also, to maintain that the rewards of labor are always ample. But would their real wages be higher under any other system that might be substituted?

Competition promotes efficient operation and technical progress. In a competitive society enterpreneurs are alert to devise and apply improved methods of operation, and to introduce mechanical inventions and technical discoveries. They have ample incentive to invent new processes, to perfect known ones, and to eliminate waste, because their costs of operation are thereby reduced, and their profits increased.

Competition leads to lower prices and better quality (or service). The reduction in costs resulting from increased operating and technological efficiency leads to lower prices and better quality. In the long run the consumer gets most of the benefit of improved methods and technological advance.

Competition has proven tremendously effective in increasing the aggregate of wealth, and thus the real income of the community. The period since the Industrial Revolution—a period characterized by active competition—is notable for such an outpouring of goods as has never before been witnessed in history, an outpouring so great from the standpoint of quantity and variety as to permit an ordinary workingman to live better than kings once lived. Truly the competitive order is a potent conjuror of worldly goods!

Competition gives producers an incentive to anticipate the wants of consumers. The wants of the people are many and varied, and the rewards of industry go to the producers who are alert to satisfy them.

Finally, competition gives the consumer a considerable measure of freedom in the choice of goods, and thereby satisfies a deep-rooted human instinct.—ELIOT JONES, *Professor of Transportation and Public Utilities, Stanford University.*

IMPORTANT NOTICE!

The Next
QUARTERLY
RESEARCH ISSUE

Originally Scheduled for Oct. 18 Issue
will appear in our
issue of
NOVEMBER 1, 1937
AMERICAN DYESTUFF REPORTER

Physical and Chemical Textile Testing

(Continued from page 602)

In the case of the spun yarns, the basis is the singles yarn which is made up of a large number of individual fibers held together by a certain amount of twist. If two or more singles yarns are twisted together we have a ply yarn and the number of plies is indicated when giving the counts, thus 40/2 or 2/40 means that two 40's singles yarns have been twisted together to give a ply yarn; it is spoken of as "forties two ply" or as "two ply forties," some localities use one phrase and other localities use the other. When two or more ply yarns are twisted together, the result is known as a cord, thus 23/5/3 is a tire cord composed of five 23's yarns plied together, and three of these plies twisted together to form the cord; it is referred to as a "twenty-threes, five-ply, three-cord."

One other type of yarn should be mentioned at this time; it is now fairly common in cheaper goods to obtain the strength of a cotton yarn combined with the appearance and feel of a woolen yarn by twisting woolen fibers about a cotton yarn in such a way as to completely cover the yarn. This is known as a "core yarn" and the counts is usually figured in the woolen or worsted system according to the yarn which it is imitating and replacing. This is not really a ply yarn, since the two types of fibers are not twisted about each other but only the woolen twisted about the cotton.

If we had a two-ply cotton yarn of which 120 yards weighed 50 grains at standard conditions, then according to previous methods of calculation the counts would be:

$$N = \frac{L}{W} \times \frac{7000}{H} = \frac{120}{50} \times \frac{7000}{840} = 20\text{'s}$$

The yarn, however, is not really a 20's yarn but is roughly two 40's yarns twisted together. The figure (20's) obtained in the above manner, in the case of a ply or cord yarn is referred to as the "equivalent singles counts", or simply as the "equivalent counts", and to obtain the true counts, it is necessary to know how much the yarn shortened in length during the plying operation; this figure is known as the "twist contraction" and its determination will be given later, for now we will give only the formula by means of which it is calculated:

$$C = \frac{F\text{-}L \times 100}{F} \qquad \text{or} \qquad F = \frac{L}{1\text{-}C/100}$$

where C = twist contraction in percent
F = original length of the singles yarn before plying
L = length of the ply yarn

Then, in the example given above, if the twist contraction was 3%, then:

$$F = \frac{120}{1 - 3/100} = \frac{120}{.97} = 123.8 \text{ yards}$$

Then, since the length of the original singles yarn was 123.8 yards and the weight was half of 50 grains, or 25 grains:

$$N = \frac{L}{W} \times \frac{7000}{H} = \frac{123.8}{25} \times \frac{7000}{840} = 41.2$$

The yarn then is not a 20's yarn, but a 41.2/2 or 2/41.2's. This is known as the "true counts" as opposed to "equivalent counts" and involves twist contraction as well as weight and length. The following examples will show the methods of calculation in other cases:

A worsted two-ply yarn of 80 yards length weighs 1.95 grams when oven-dry, the twist contraction was 5%. What is the equivalent counts of the yarn and what is the true counts?

$$W = 1.95 \times 15.4 \times 1.13 = 34.0 \text{ grains}$$

$$\text{Equivalent counts} = \frac{80}{34.0} \times \frac{7000}{560} = 29.4\text{'s}$$

$$F = \frac{80}{1 - 5/100} = \frac{80}{.95} = 84.2 \text{ yards}$$

$$\text{True counts} = \frac{84.2}{17.0} \times \frac{7000}{560} = 62.0$$

The yarn is 62/2 or 2/62's worsted.

A cotton cord is composed of three ply yarns twisted together with a twist contraction of 6 per cent. Each of the ply yarns is composed of two singles yarns twisted together with a twist contraction of 2 per cent. On weighing 120 yards of the cord, it weighed 18.0 grams when oven-dry. What is the true counts of the cord?

$$W = \frac{1}{6} \times 18.0 \times 15.4 \times 1.07 = 49.4 \text{ grains}$$

Length of ply yarn before cording

$$= \frac{127.7}{1 - 2/100} = \frac{127.7}{.98} = 130.2 \text{ yards}$$

$$\text{Then } N = \frac{L}{W} \times \frac{7000}{H} = \frac{130.2}{49.4} \times \frac{7000}{840} = 22.0$$

The cord is 22/2/3 cotton.

For many purposes, the twist contraction may be neglected and an approximation is obtained which is satisfactory for the purpose; an example follows:

Five-gram skeins of a 20/2 spun silk yarn are desired for dyeing tests. How much should be reeled off (at standard conditions)? Neglecting twist contraction, a 20/2 yarn is equivalent to a 10's single yarn. Five grams

$= 5 \times 15.4 = 77.0$ grains. Then,

$$N = \frac{L}{W} \times \frac{7000}{H}$$

$$10 = \frac{L}{77.0} \times \frac{7000}{840}$$

$$L = \frac{10 \times 77.0 \times 840}{7000} = 92.5 \text{ yards}$$

Then, 92.5 yard skeins would give skeins which are close enough to the desired weight for the purpose.

REFERENCES:

[1]Haven, G. B. Mechanical Fabrics. John Wiley & Sons, Inc., New York (1932).

[2]Saxl, I. J. Rayon and Synthetic Yarn Handbook. Rayon Publishing Corp., New York (1936).

Twist

Twist is the spirality given to a yarn in order to hold the constituent fibers or yarns together. Up to a certain point, an increase in the twist tends to make a stronger yarn; but above this point, the additional twist adds a strain to the fibers which results in a weaker yarn. In general then, there is a certain limited range of twist which is desirable; for certain effects however, less twist (soft twist) or more twist (hard twist) may be necessary. According to the kind and amount of twist, yarns may be classified as:

1. Singles yarn—see preceding section.
2. Ply yarn—see preceding section.
3. Cord—see preceding section.
   a. Hawser twist
   b. Cable twist
4. Core yarn—see preceding section.
5. Crepe yarn—yarn with a large amount of twist, usually held in place by a coating of gelatine size.
6. Novelty yarn—yarn of non-uniform twist where strength is sacrificed for appearance.

Two general methods of measuring twist are available: (1) a microscopic method depending upon the measurement of the angle of spirality (helix angle), which will not be taken up at this point; (2) a method using a "twist counter" which untwists a given length of yarn and measures the number of turns necessary.

Reduced to fundamentals, the twist counter consists of two jaws, one non-rotating but movable on a rod, so that the distance between the jaws may be varied, the other jaw fixed in position but capable of rotation by means of a handle, and with a revolution counter attached to read the number of turns.

In taking the yarn from the packages to test for twist, the yarn should be drawn off from the side of the package and not over the top, otherwise an additional twist would be added to or taken away from the yarn. The yarn should be tested in successive lengths, with only an inch or less between samples, so that a record of the variation of the yarn will be obtained. The yarn is untwisted by the rotating jaw and the number of turns of the jaw divided by the distance between the jaws (gauge length) gives the "turns per inch," usually abbreviated and referred to as TPI.

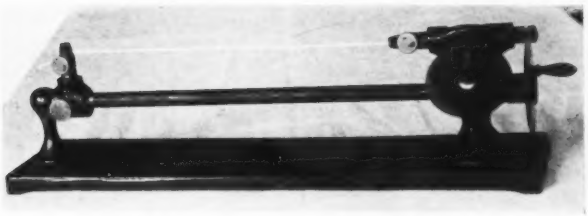


Fig. 17—Simple Twist Counter

The simple twist counter (Figure 17) is used as follows:

1. The gauge length is set at ten inches and the ply yarn clamped in the jaws; the yarn should be straight but not stretched. The revolution counter should be at zero.
2. The rotating jaw is revolved until all the ply twist is removed and the strands are parallel, so that a needle may be passed between them from one jaw to the other.
3. The number of turns of the rotating jaw as shown by the dial is recorded. This value divided by 10 (gauge length) is the TPI of the ply yarn. Since the dial usually reads only up to 100 revolutions, a note should be made of the number of complete revolutions of the dial.
4. With a sharp razor blade or scissors, all but one of the singles yarns are cut from between the jaws.
5. Holding the left end of the single yarn so that it will neither twist nor untwist, the non-rotating jaw is moved up to the correct gauge length for the singles yarn, which is then clamped in place. The gauge length for singles yarns is one inch for cotton and four inches for woolen and worsted yarns.
6. The singles yarn is untwisted by rotation of the revolving jaw until the fibers are as nearly parallel as possible. A magnifying glass helps to determine when the fibers are parallel in a cotton yarn; in the case of woolen and worsted yarns, a needle may be used as for ply yarns.
7. The number of turns registered on the dial is read again and divided by the gauge length to obtain the TPI of the singles yarn.

A convenient method of recording and calculating results is shown herewith:

	Ply Twist		*Singles Twist*	
Balance:	(see later)			
Direction of twist:	(see later)		(see later)	
Gauge length:	10 inches		4 inches	
Twist:	110 turns	= 11.0 TPI	24 turns	= 6.0 TPI
	114	11.4	25	6.3
	96	9.6	22	5.5
	106	10.6	24	6.0
	110	11.0	27	6.8
	Total	53.6		30.6
	Average	10.7 TPI		6.1 TPI

As shown above, at least five determinations should be made on each sample and preferably ten determinations. In testing a shipment of yarn, at least five samples and

preferably more should be taken. The results may be calculated according to the methods of Chapter 1 to get true value and variation of the yarn.

The simple twist counter gives results accurate enough for all ordinary purposes, but these points should be noted:

1. The tension on the yarn when placed between the jaws is a variable quantity. Great tension would result in fewer TPI, less tension would result in more TPI.

2. In the case of singles cotton yarns particularly, it is difficult to decide just when the fibers are parallel, since opposite twist may start to go into some fibers before others are wholly untwisted.

3. On untwisting a ply yarn, the yarn slackens between the jaws due to removal of the twist. This expansion of the yarn is equal to the twist contraction (mentioned in the section on Plies) and should be measured if the true counts of the yarn is to be determined.

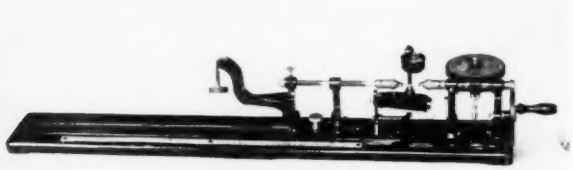


Fig. 18—Accurate Twist Counter

The more elaborate twist counter, shown in Figure 18, takes the above points into consideration. This instrument is similar in principle (although usually larger in size) to the simple type with the exception that the non-rotating jaw is capable of sliding in a sleeve and has a constant tension device on which the tension may be varied by means of weights; also the sliding arm is calibrated so that twist contraction may be read. It is used as follows:

1. With the sliding arm clamped at zero, the revolution counter at zero, and a gauge length of ten inches, place the ply yarn between the jaws.

2. On the constant tension device place weights to give the following tensions (in grams):

$$\text{Cotton yarn tension} = \frac{156}{\text{equivalent cotton counts}} = \frac{131}{\text{Type number}}$$

Woolen and worsted yarn tension = weight of 100 yards of yarn

Rayon yarn tension = 10 grams (for 75d or finer)
20 grams (75d to 150d)
30 grams (coarser than 150d)

3. Release the clamp on the sliding arm and read the extension.

4. Remove the ply twist, read the extension and the revolution counter; divide by the gauge length.

5. Remove the tension weights except just enough to keep the singles yarn straight without causing the fibers to slip. This value should be determined by a preliminary experiment.

6. Reset the sliding arm, cut out all singles yarns but one, reset to new gauge length (holding the twist in the singles yarn, meanwhile); release the sliding arm, note the extension.

7. Untwist the singles yarn, an extension will show on the sliding arm, continue turning in the same direction until an equal twist in the opposite direction is shown by the sliding arm coming back to its first position. Read the dial and divide by twice the gauge length.

An example of the data and calculations for the more accurate twist counter follows:

	Ply Twist			*Singles Twist*	
Balance:	(see later)				
Direction:	(see later)			(see later)	
Gauge length:	10 inches			1 inch	
Twist:	Turns	TPI	Extension	Turns	TPI
	168	16.8	.20	18	9.0
	170	17.0	.25	16	8.0
	165	16.5	.23	20	10.0
	166	16.6	.25	18	9.0
	172	17.2	.25	17	8.5
Total		84.1	1.18		44.5
Average		16.8	.235		8.9

The per cent twist contraction is calculated from the formula previously given:

$$C = \frac{F\text{-}L}{F} \times 100$$

where C = % twist contraction
F = original length of the singles yarn before plying
L = length of the ply yarn

In the above case, the calculation is:

L = 10 inches
F = 10 + 0.235 = 10.235 inches
F-L = 0.235 inches

$$\text{then, } C = \frac{0.235}{10.235} \times 100 = 2.30\%$$

Note that the formula for twist contraction may be expressed as:

$$C = \frac{100 \times \text{extension}}{\text{gauge length} + \text{extension}}$$

These more accurate twist counters may also be obtained with a motor driven revolving jaw, a rather unnecessary refinement, since the time required to untwist a sample is small compared to the time required for adjusting tensions, setting gauge lengths, and recording data.

The A.S.T.M. tolerances on twist are given in Table IX.

In describing the direction of twist, there was for years much confusion since it was referred to as "right hand" or "left hand" twist. Some branches of the industry described as "right hand" yarn which was twisted by turning to the right, while other branches described as "right hand" yarn which was untwisted by turning to the right. The A.S.T.M. method of describing direction of twist is

to be preferred. This system describes the twist as "S" or "Z" according to the following definition: "a yarn or cord has S twist if, when held in a vertical position, the spirals conform in slope to the central portion of the letter 'S', and Z twist if the spirals conform in slope to the central portion of the letter 'Z'." Figure 19 illustrates both types of twist.

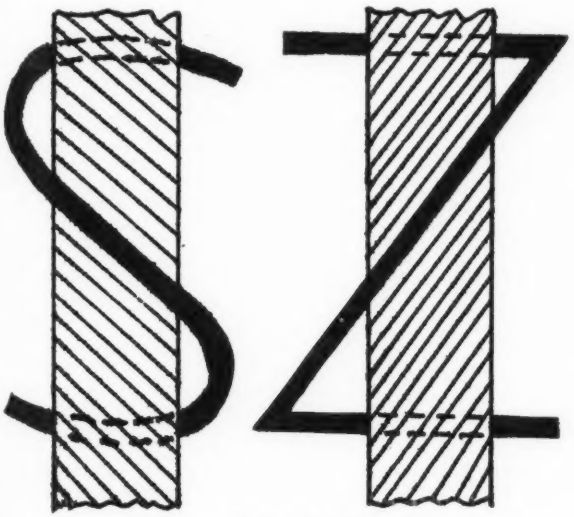


Fig. 19—"S" and "Z" Twist

In plying yarns, the ply twist is usually, although not always, opposite to the singles twist. Cords are of two types: hawser twist and cable twist. Hawser twist has the singles twist and ply twist in the same direction and the cord twist in the opposite direction; tire cords, for example, have the singles yarns of Z twist, ply yarns of Z twist, and cords of S twist. Cable twist has the ply twist opposite to the singles twist, and cord twist opposite to ply twist; a cabled cord, for example, might have singles yarns of Z twist, ply yarns of S twist, and cords of Z twist.

A yarn is said to be in balance if the amount of twist is just enough to keep the component yarns or fibers in position. If more twist than this is put in, the yarn will kink and snarl; if less twist is put in, the yarn will tend to untwist and again will kink. For knitting machines and sewing machines, especially, the question of balance in the yarn used is very important. A yarn is tested for balance by taking a one yard length in the hands, each end held by thumb and forefinger of one hand, and bringing the ends together. If the yarn hangs in a loop without twisting about itself, it is in perfect balance; if it twists about itself, it is not balanced. A rough indication of unbalance is obtained by noting the number of times the yarn twists about itself, but usually a yarn is reported simply as "balanced" or "not balanced." Figure 20 illustrates balanced and unbalanced yarns.

In making a ply yarn, all the singles yarns should twist about each other equally, so that when a load is placed on the yarn each strand will take its share of the load; if, however, one yarn is straight and the others are twisted about it, applied load will all be taken up by the straight yarn until it snaps, when the load will then be applied to the others. This type of twist is known as "corkscrew twist" and is shown in Figure 21. Corkscrew, while generally undesirable, is sometimes obtained deliberately for the manufacture of novelty yarns.

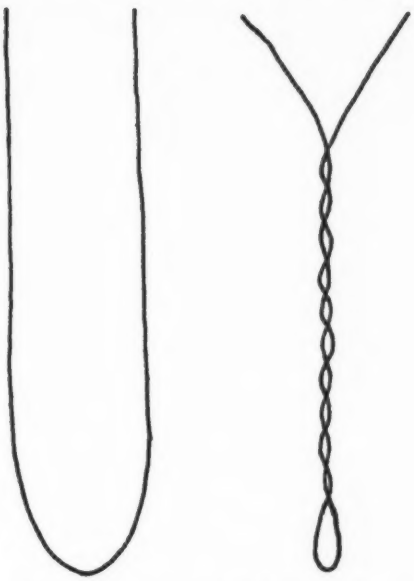


Fig. 20—Balanced and Unbalanced Yarn

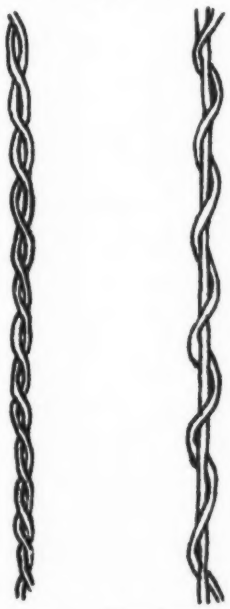


Fig. 21—Regular and Corkscrew Twist

There are several causes of corkscrew. If one yarn is under greater tension than the others, it will tend to be straight while the others corkscrew about it. If one yarn is fed straight into the twister while others come in at an angle, corkscrew will result. The number of plies in a yarn may determine corkscrew; thus a five ply yarn has little tendency to corkscrew, the five yarns arranging themselves on the circumference of a circle; a six ply yarn, however, will nearly always corkscrew since one of the plies is forced into the center of the circle of yarns; it is for this reason that tire cords, where a maximum of strength is required, are made five ply. In general, three, five, and eleven ply yarns seem to have the least tendency to corkscrew. Size of yarns also is a cause of corkscrew, combining a thin and a thick yarn nearly always resulting in a corkscrewed yarn.

Corkscrew is measured by taking a long length of yarn, attaching a small weight to each ply (to give constant tension), and untwisting the yarns; the length of each ply is measured, the average length obtained, and the deviation of each length from the average is calculated. The sum of the deviations expressed as percentage of the average length is the per cent corkscrew of the yarn. Obviously, if there were no corkscrew all the lengths would be the same, the deviations and the per cent corkscrew would then be equal to zero. Haven has described a convenient apparatus for this determination, but for only occasional determinations a yardstick and a number of small spring paper clamps may be used, the paper clamps acting as the tension weights.

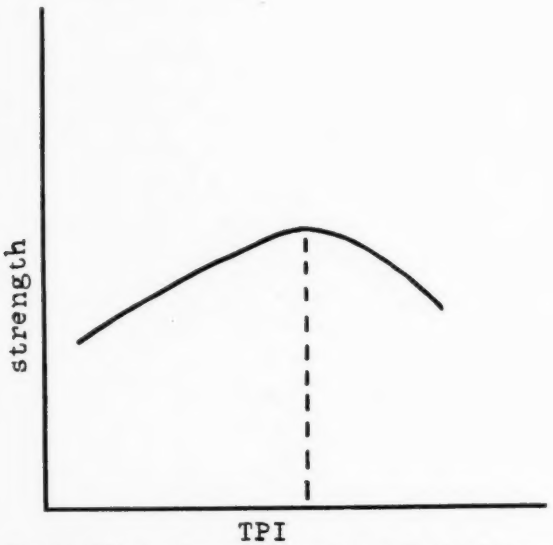


Fig. 22—Relation Between Strength and Twist of Yarns

As indicated in the introductory paragraph of this section on Twist, the maximum strength of a given counts of yarn is obtained with a definite amount of twist; this relationship is shown graphically in Figure 22. The usual method of expressing the relationship between counts and twist is by the formula:

$$TPI = K\sqrt{N}$$

where TPI = turns per inch
N = counts of the singles yarn
K = twist factor

It has been established by experiments and practice that the maximum strength of a yarn is obtained for a definite value of K; in the case of ring-spun cotton yarns, for example, the following values of K have been found to give the best results:

Warp yarns, 35's and less	4.75
Warp yarns, 35's to 80's	4.50
Warp yarns, 80's to 110's	4.25
Filling yarns, medium numbers	3.50

Filling yarns usually have a lower twist factor because strength is not so important and appearance is more important. Ply yarns frequently have twist factors of 4 to 6, while crepe yarns are often twice or three times ordinary yarns.

REFERENCES:

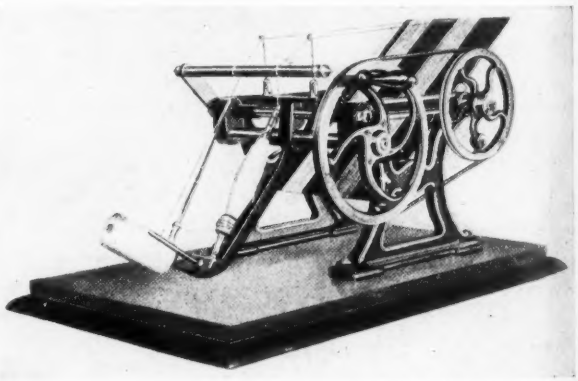
[1]Haven, G. B. Mechanical Fabrics. John Wiley & Sons, Inc., New York (1932).
[2]Saxl, I. J. Rayon and Synthetic Yarn Handbook. Rayon Publishing Corp., New York (1936).
[3]A.S.T.M. Standards on Textile Materials. A.S.T.M., Philadelphia (1936).

Seriplane and Regularity

Methods for determining the regularity, uniformity, or evenness of yarn samples may be classified as follows:

1. Statistical methods
   a. Counts
   b. Twist
   c. Strength
   d. Thickness
2. Visual inspection—seriplane or inspection boards.

The use of statistical methods depends upon making a large number of physical tests of one kind, such as counts or twist, on a large number of small samples; the results are then computed as discussed in Chapter 1 so as to determine the per cent variation. Thickness has also been used for this purpose, methods having been developed for measuring the thickness of yarns by recording feeler gauges of various types. The use of the microscope for measuring the width of yarns has also been suggested. All of these methods, however, simply give the uniformity of the yarn as regards one variable. For example, the yarn might be very uniform as regards counts but the twist might be very uneven. Strength tests are better in this respect and will be discussed later.



Courtesy of Henry L. Scott Co.

Fig. 23—Seriplane or Yarn Inspection Board

The most common way of comparing yarns for uniformity is by means of the inspection board or "seriplane." The seriplane (Figure 23) was originally devised for use in the silk industry but has been extended to other textile branches; it consists essentially of a device for winding yarn at even intervals around a board of a color contrasting with the yarn. The seriplane, in its simplest form, winds yarn from one or two packages on a black board; machines are made, however, which wind a large number of boards at a time. After winding, the board is viewed at

a little distance for general evenness or density of yarn, looking especially for streaks. The boards are then examined more closely for:

1. Thick and thin places
2. Slubs—bunches of loose fiber caught in the yarn
3. Uneven twist
4. Corkscrew twist
5. Oil or rust spots
6. Hairiness—excessive number of protruding fibers
7. Broken filaments, in the case of silk or rayon.

The test is, in general, qualitative but it may be made roughly quantitative by counting the number of imperfections per board. Permanent records may be made by photographing the boards, to be compared later with other photographs. Standard photographs of raw silk are obtainable from the Silk Association of America for grading silks numerically.

REFERENCES:

[1]Haven, G. B. Mechanical Fabrics. John Wiley & Sons, Inc., New York (1932).

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(To be continued)

Textile Institute Conference

Southport, England, June 9-11, 1937

Discussion on Serviceability of Fabrics in Regard to Wear—Reported in Part

The Serviceability of Fabrics in Regard to Wear

DR. F. T. PIERCE

THE textile technologist reacts to the word "wear" by designing a machine to grind a hole in cloth with emery. Then one fabric may show a hole after 100 rubs, another after 120 rubs. And so what?

Early in my experience of testing I met the problem of the wear of varnished healds. Tested by rubbing against emery, the more serviceable wore to fracture more rapidly. Its established superiority in practical performance lay in its hardness, a quality which protected it from abrasion by cotton and size, but did not avail against emery. Softer materials may suffer less abrasion simply because they resist less. Microscopic examination of cloth rubbed against emery or carborundum shows the lesions of the hairs to be tiny, clean cuts. The emery surface itself is seen to be covered with cutting edges as keen as razor blades, and harder. In use also fabrics develop holes: but the similarity between the causes and effects is not sufficiently close to warrant any assumption of similar behaviour in use and test. Many holes in worn garments have been examined at the Shirley Institute and none at all like those produced by the usual kind of "wear test" against emery.

Many other kinds of tests have been devised to imitate the deterioration of fabrics in use. A strip of fabric is subjected to a steadily increasing tension till it breaks, but it must be admitted that this happens more frequently in a testing laboratory than in wear. Ability to withstand tensile stress is undoubtedly a feature in serviceability, but is not a sufficient measure of serviceability. The various destructive agencies co-operate and a truly imitative test must combine them as in use. Even under normal storage conditions, chemical deterioration proceeds continuously. A common test for "ageing" consists in measuring the strength before and after a heat treatment. It is a big assumption to make, that this will foretell the deterioration in years of careful use yet it is imperative to speed up some actions a thousandfold to make tests practicable, and heat ageing is the simplest of these.

Serviceability is not concerned only with the formation of holes in the fabric. Of features distinct from strength, length is perhaps the simplest but the imitative test of shrinkage provides pitfalls enough. Laundry machines are sometimes used for testing, but actually, the shrinkage is not at all sensitive to details of the machinery so long as the material is thoroughly wetted out and given a fair amount of mechanical agitation. Small details of the procedure of drying and pressing are more important. Nor is the percentage shrinkage a direct measure of serviceability. a test to produce maximum laundry shrinkage may produce a slack fabric easily capable of being stretched back 1% to its original dimensions; another fabric might shrink only ½% but resist re-stretching and cause trouble as a hat or shoe lining. On the other hand, stretching may cause bagginess and affect serviceability.

One might continue beyond all patience in pulling to pieces the numerous imitative tests constantly being put forward—and scrapped.

A valid imitation of service could be devised only after a thorough survey of the behaviour in use of each fabric

—analytical to determine the nature of the causes and effects of deterioration, statistical to determine their relative importance. But when such a survey is made, better use can be made of it than the design of an imitative test. Weak features can be corrected and economies made at the expense of the strong, so that the imitative test would no longer be valid. A holiday tent of flax canvas used, on account of its weight, to need a mule for transport. After a study of performance in the field, it was found that the heavy stresses could be put on a frame of tapes and the walls be made of the finest waterproofed cotton material, so that good service is obtained with a weight suited to a rucksack. Serviceability depends on making-up as well as fabric manufacture, in regard not only to the duration of useful life but also to the features that cause failure. In short, imitation is no substitute for understanding. This does not mean that testing is futile, but that its function is not mere imitation.

The relation between character and behaviour is the way of scientific progress. If the environment is simple, constant and known, the behaviour of objects therein indicates their character. From the known character, the behaviour of an object in any environment may be deduced, in so far as the pertinent facts and relations are known.

According to these prinicples, the scientific approach to our problem would be (*a*) on the one hand, to determine the character of a fabric not by "wear tests" but tests of staple, structure, strength, resistance to abrasion, etc.; (*b*) on the other hand, to analyse behaviour in service to determine the destructive agencies, the effects they produce and their relative importance; (*c*) then to correlate the measured characters with the effects produced by the several important and essential types of destructive action.

In the present state of the subject it does not seem possible completely to correlate behaviour in service with the simplest characters alone—structure and chemical composition. Hence we must accept direct tests of more complex behaviour, strength, resistance to abrasion, etc. These should, however, be designed as tests of character, with simple conditions idealizing the essential types of destructive action.

Quantitative surveys of the deterioration in use of garments are difficult to carry out, but the prediction of serviceability must contain a large element of guesswork till they are made. It is difficult to gain significant information on the behaviour in use of lines that change in quality. Standardized lines, especially when regularly supplied to large institutions, promise the easiest field for effective statistical treatment. In the meantime, one must rely on general experience and the examination of random samples of goods in service, including complaints arising in commerce.

This unsystematic body of knowledge is sufficient for the correction of isolated features that produce distinctive types of failure. Of two samples one was found to wear out more quickly than another. They proved identical in structure, save that the former had a larger proportion of short fiber. This provided an obvious explanation in accord with the appearance of the frayed yarns, and an obvious method of improvement. A semi-stiff collar cracked at the fold and an analysis of structure suggested modifications that provided more "give." Undue weakness of white goods is often shown by fluidity to be due to overbleaching. This is a good example of the character test, for the measurement of the fluidity of a solution of cotton in cuprammonium could not be farther removed from an imitative test of disruption, but no test is of more general value.

Some of the points may be brought out by a mere recital of a random selection of investigations into serviceability: wearing into holes, and threadbareness of shirts, sheets, hose, rubbered raincoats, upholstery, overalls, etc., tearing at seam, fraying, creasing, loss of pile or nap, loss of lustre, shininess, loss of shape, shrinkage, sagging, stretching, puckering, curling, weathering, mildew, abrasion, tearing, changes of permeability and water resistance, heat tendering of calender covering, light tendering, etc., etc.

Practical service trials might, of course, often be controlled and intelligently simplified to yield useful results more quickly than a statistical survey of uncontrolled consumer use, *e.g.*, drop tests for parachutes or road test for motor tires.

Coherency

The most familiar example of an integrated test is the tensile test for strength. Regarded as an imitation of the breakdown of a fabric in use, it is open to severe criticism on many points; but regarded as a test of character, supplementing structure tests, it gives information on the coherency of the fabric that is of undoubted value. That value depends more on the understanding of the effects of tension and on empirical correlation with service than on details of mechanical similarity between use and test.

The character of coherency against tension is not the only feature necessary in a fabric to withstand wear. Rather than devise endless imitations of wear it appears however more fertile to enquire what these other features are and to devise tests for them. The behaviour in use most directly related to coherency when not under tension is resistance to abrasion—not to cutting actions, but to rubbing to and fro that tends to drag the fibers apart by friction and break them only one by one as they become isolated. This is like the untying of a knot by a neat-fingered woman, where tension is like a strong man tugging at it.

Other factors in use that tend to tease the fibers apart and weaken the structure are oscillations of tension and bending, which cause the fibres to move relatively to each other. Abrasion tests are sensitive to the microscopic form and chemical state of the surface, so may usefully be supplemented by other disintegrating tests.

Sharp bending ("cracking test") may disrupt the fiberous or other material itself, in a brittle fabric such as starched, oiled or doped fabric or cloths with yarns of bast fibers.

Quality

Many a garment is discarded without such indubitable evidence of wear such as disruption; the character has changed so as to render it unsuited to its purpose. Here enters another function of testing, again to test character, but as a measure of quality rather than behavior, *e.g.*, changes in length measurements, lustre or color. The method of expressing the result of a test of gradual deterioration comes into question. The easiest method is to impose a certain amount of treatment—rubbing or what not—and measure the quality of importance before and after. If, however, the quality measure corresponding to the unserviceable condition can be determined, it is more to the point and simpler to determine the amount of treatment necessary to produce this condition. Thus, the number of bends in a cracking test, which make an oilskin permeable to water, may be determined as "useful life"; or the number of rubs necessary to produce unsightly hairiness on a sateen lining.

To determine the end-point of the test, it will, however, be necessary to give a graded series of treatments and obtain the curve of the quality measure against amount of treatment. A general relation may then be indicated, and two or three points will suffice to determine the whole curve. Such a relation has been found between heating and fluidity (or strength) of cotton materials.

Condition During Service

The end-point at which a material must be discarded is not, however, the only measure of serviceability. The quality of the brand new cloth is of interest, the duration of its useful life also, but its quality during the period of service is surely pertinnent also to its serviceability. This is one reason for the superiority of the curve mentioned above over the test by one standard amount of treatment or the determination of end-point only.

The conditions of the actual durability test may also take account of conditions of service without degenerating into complex and arbitrary imitations. If a garment, such as a woollen overcoat, is weaker and more severely treated in service while wet, a test in the wet condition is more pertinent and no more complex than in any arbitrary moisture condition.

Statistical Considerations

The effects of these normal structural variations must be allowed for by normal good practice in sampling and analysis. Beyond this, however, the serviceability of a garment is also subject to the "weakest link" principle and by variability. A general averaging of results of a set of tests to give a measure of serviceability tacitly assumes that the fabric will remain serviceable in every way and part, till at some moment it ceases to be—an awkward contingency for apparel from which the imperfections of textile technology will long save us.

A simple example of this point is found in the breakage rates of warps, which show a minimum at a certain percentage of size. Tested by rubbing, the warps show rapidly increasing resistance as the size is increased from low values, with little but still positive effect at higher values, *i.e.*, no optimum value. But the extensibility shows a reverse effect and the optimum in weaving may be ascribed to the change over from abrasion to brittleness as the feature productive of breakage. Probably the most fertile application of testing in regard to serviceability is not in foretelling duration of life but in correcting weak features.

The essentially statistical character of any sound interpretation of destructive tests emphasizes the importance of the statistical analysis of the results thereof.

The Wearability of Fabrics

C. M. Whittaker, B.Sc.

I AM accepting wearability of textiles as a word which includes several factors amongst such as structure, resistance to light, washing, friction, perspiration, seawater, etc.

"Cloth structure" might be paraphrased as "cloth restriction" because the main efforts appear to be directed to see how much may be left out to meet a price, and the devil take its wearability. The Sales of Goods Act (1893) states that a textile fabric must be of merchantable quality and reasonably fit for the purpose for which it is sold. Claims do not proceed because of the slogan "the customer is always right," but if they did would the judge interpret "reasonably fit" as demanding dyestuffs of the highest available fastness to light? Would he take the price factor into consideration? New entrants to the home market have cut prices to obtain a footing, with the result that the wearability of many lines of fabrics has been a secondary consideration to the price.

It is debatable whether the hard wearing properties of the fabrics of a generation ago are desired by the present generation. The idea of wearing for a lifetime a suit of broadcloth as our ancestors did has been substituted by two or three suits at 37s. 6d. to 55s. and a varied assortment of flannel bags and woollen pullovers.

Another modern development is the manufacture of branded articles of which the retail price is fixed by the manufacturer. The profit ratio of the distributor is like the laws of the Medes and Persians in that it altereth not. What are the other means of meeting the recent increase in price of basic raw materials, say, wool? The alternatives are:

1. Grinding the face of the manufacturer, dyer and finisher.
2. The quality is lowered by using a cheaper grade or mixing it with a cheaper raw material.

Whichever route is followed it means a lower quality and, therefore, a reduced wearability. The modern retail policies, which mean large quantities of one quality, style and size, make it possible to supply articles of a certain standard of wearability which had hitherto not been achieved at that price. Such policies do, however, in a

rising market inevitably mean that quality and wearability have to suffer if the fixed price and fixed distributing profit have to be maintained.

The straightforward shopkeeping movement with its desire to set up standards for the retailing of textile merchandise is a recognition—if somewhat tardy—that rubbishy textiles of poor wearability have become too prevalent and that it is desirable to endeavor to raise the standard.

Many buyers of textiles of inferior wearability defend themselves by saying that they only deal with reputable firms—would that it were so. Technical knowledge of the merchandise is not rated very high amongst retailers.

One practice of the retail trade which has a pernicious influence on the quality and wearability of textiles is the wide gaps they maintain between rigid selling price levels. How often have not both the textile manufacturer and processer, who have suggested an improved construction or a faster color at a small increased cost of ½d. or 1d. per yard, or even less, been told that the extra price could not be paid because it would lift the retail price, say from 1s. 11¾d. to 2s. 5½d.

It does seem to me that textile merchandise has to carry an increasing amount of over-heads in distribution. Is it really necessary to have all the mumbo-jumbo to be found in the modern store?

Speaking as a dyer, there is no doubt that at various stages between the dyer and the ultimate consumer there are standards laid down which are not demanded by the ultimate consumer and which have not the least influence on the wearability and usefulness of the txetile. I have here four labels for which the colored viscose was dyed in my dyehouse with vat dyestuffs. One of these labels is the standard and the other three represent the dyeing to the standard which dyeing was rejected for being off shade. Is it conceivable that the microscopical difference in shade between the labels would influence in the eyes of the ultimate consumer the sales appeal or the wearability of the garment to which it was sewn?

It is part of my occupation to dye viscose rayon skeins for the lingerie and smallware trade in which the variety of the shades and the hairline distinction between the tones demanded is ridiculous. I have dyed for one firm in eight months 104 pinks. This variety of shades is not the demand of the ultimate consumer, and has no bearing on the wearability or attractiveness of the final garment.

This insistence on useless points adds unnecessarily to the cost of the article because a reasonable standardization of shades would lead to lower costs due to the bigger bulk orders which would ensue and the simplifiaction of stocks. Moreover, this lowering of price would not be obtained by the all-too-frequent lowering of quality.

It always seems to me that manuafcturers as a class have a great lack of knowledge of dyestuffs and their fastness, because ignorance is the only explanation of some of the weird combinations of fast and loose dyes found in one and the same fabric. A tie labelled "fadeless" was dyed one thread with sulfur colors and one with vat colors. It was a misdescription to label it "fadeless." Again it is obviously ridiculous to use for making tie-cloth one vat-dyed thread and one sulfur brown thread; either one thread is too fast or one thread is too fugitive.

A worsted manufacturer will pay great attention to every stage of his process to taking the grey piece off the loom, and has no knowledge whatsoever of the dyeing process which controls the saleability and in some respects the wearability of his pieces. He cheerfully proceeds to pay a price for dyeing which, if he had any knowledge of dyeing, he would know was not the price for a good job but must result in inferior work.

Another case of ignorance or lunacy occurred in a four-fold fancy colored yarn used in a casement cloth. The four threads were:

Emerald Green	Basic
Dark Green	Caledon Jade Green
Tango	Direct Cotton
Brown	Direct Cotton

and ironically the heaviest dyed shade of the four, namely, the dark green, was vat dyed.

I have always considered that the heavy sizing of dungarees does not reflect favorably on the intelligence of the textile trade. The warp man has to size warps to 50% increase on grey weight with starch, china clay, etc. The resulting warps are very liable to dust off, so that he frequently has to board off a special section in order to avoid soiling other material. This weighting has not the least influence on the wearability as all the size and weighting comes out in the washtub.

From the point of view of color fastness it must be generously admitted that the dyestuff manufacturing industry has played its part admirably in making it possible to color fabrics so that their wearability fits their purpose. Nowadays there are very few gaps in the groups of dyestuffs which are available for the various fastnesses demanded by the textile trade.

It is to be deeply regretted that although the dyestuffs which are available to enable a satisfactory wearability from the point of view of color fastness to be given, many buyers refuse to pay an economic price for their production, so that inferior dyestuffs have to be substituted to the detriment of the wearability. Fabrics of high resistance to light and washing may be produced at a price which many manufacturers refuse to pay. One result is that casement fabrics of inferior fastness to light and washing are coming on the market in increasing quantity.

Everybody agrees that no such thing as a fadeless dyestuff exists. The dyestuff manufacturers with admirable consistency refuse to guarantee the fastness of their dyestuffs, but the dyers continue to do so; moreover, they are increasingly degrading this guarantee by using direct cotton colors which every cotton dyer knows are not comparable—with but few exceptions—to the best vat dyestuffs.

Casement curtains to be usable require to be dyed with

dyestuffs which do not accelerate the photo-degradation of the fibers. All fibers are susceptible to photo-degradation—natural silk being the most sensitive. It has, however, been established by several workers that certain vat dyestuffs do accelerate this photo-degradation. A list of these dangerous vat dyestuffs has been published by agreement, and anybody who continues to use them cannot plead ignorance.

Dermatitis is connected with the wearability of textiles, and until idiosyncrasy is accepted by the Courts as a defense the suppliers of textiles may rightly consider themselves to be placed in an unfair position. Unlike a doctor who may use a drug, the supplier of a textile towards which some subject is idiosyncratic is held liable for compensation even though two qualified analysts testify that the garment was normally dyed according to the best current practice. Fortunately, medical opinion is becoming much more definite on its causation, which opinion must finally influence legal decisions.

During recent years of depression several new processes have been introduced which may be acknowledged as definite improvements in the wearability of fabrics. The Tootal process of making fabrics crease-resisting by incorporating the new synthetic resins in the fabric structure has clearly filled a gap in the wearing properties of fabrics. The intensive work which has been and is being carried out as evidenced by patent specifications must finally result in many new and favorable applications of the fundamental basis of the process. Synthetic resin is so new an industry that progress must be inevitable. Trubenised collars are now a commonplace line in men's outfitting shops. which clearly shows that this development has satisfied a demand for ease of washing without the subsequent starching. Shrinking has been one of the great defects in the wearability of fabrics. Now the Rigmel or Sanforizing process has made it possible for unshrinkable fabrics of vegetable fibers to be produced. Recently A. J. Hall announced a new process for making woollen garments unshrinkable for which superior results are claimed over the established chlorine process.

Color Fastness

Dr. P. W. Cunliffe

IT has been said that the degree of fastness which can be expected of a textile is that of its useful life; this may be a vague period, but it does at least give some sort of basis on which to work. It is thus necessary to allow for a wide range of fastness. The range of fastness to light of present-day dyes is very considerable, and while some may be regarded as out-of-date, there remains a use for many of relatively poor fastness, owing to their possessing other valuable properties.

Tests for the fastness of dyes to light have been in use for a long time, but standard methods have not been available until the last few years. The ideal way of approaching this problem would be to expose the material to be tested for a given time to a source of light of sunlight quality and to measure the color, before and after fading, on a colorimeter, expressing the change in color as a certain number of least perceptible visual steps. The color measurement portion of the method presents the greatest obstacle, since the data required for converting instrumental data into visual steps are inadequate. Exposure to a light source of the type mentioned is, however, practicable.

Many of the difficulties of testing are obviated if there is available a range of colored surfaces of graded fastness which can serve as standards, against which test samples may be compared. These behave virtually as light integrators, thereby allowing the use of a source of light of variable quality and intensity. Considerable work has been carried out in this and in other countries on the production of such a range. The national committees on fastness of America, England and Germany have recently come together in an endeavor to agree on a common set of standards. Considerable advance has been made, and it is confidently expected that at the conclusion of a series of tests being made this summer, this desirable object will be achieved. Here, then, will shortly be available a range of eight standards accepted internationally. There appears to be an excellent opportunity of making the fullest use of a system so widely agreed upon.

The problem of testing the fastness to light is not entirely solved, however, by means of standards. In the first place, the standards so far proposed are all in medium to dark shades. A difficulty at once arises when the fading of a pale shade is to be compared with that of the deeper standards. Moreover, the standards of the Society of Dyers and Colourists comprise a range of blue and a range of red dyeings only, while those of the German committee are in blue only. In comparing a yellow, for example, with such hues, a personal factor enters to an appreciable extent.

The washability of textiles involves either the fastness of the color or the tendency to shrink, or both. The investigations of each of the three national committees previously mentioned have resulted in a series of tests for each country. Considerable differences between the three series are found. It may be noted that the German tests are out by the plaiting method and in beakers, while the American and British tests require a Launderometer or experimental wash-wheel. This naturally limits the use of the tests to those possessing such a device. The tests put forward by the Society of Dyers and Colourists for fastness to washing are concerned with cotton only. The need for a standard test for wool materials has been recognized for some time by the Wool Industries Research Association, who have now begun investigations on this subject. It is also rather surprising to find that no method of test for shrinkage has been published for fabrics made of wool. It is anticipated that procedures for the determination of fastness and shrinkage of wool fabrics will shortly be published as provisional standards.

Testing and Inspection of Fabrics

W. Pritchard, A.T.I.

THE L.M.S. Railway Company are purchasers of textiles to the extent of £750,000 per annum, and this will indicate the necessity of standard tests to enable material to be passed quickly into use.

Testing is of the greatest value to the sound efficient manufacturer, and the more strict it is, the more he should thank his customer, because he knows that the cheap price and low quality of unscrupulous competitors will have no chance so far as his own products are concerned.

There is, however, a growing tendency for manufacturers to produce a fabric to the price quoted rather than to the standard pattern and/or specification, with the obvious result that testing becomes more exacting and more severe. When times are difficult and purchasing restricted, competition becomes keen and we are faced with materials made to fit the price. On the other hand, when trade is good, we find manufacturers passing fabrics in which count, quality and workmanship are inferior, knowing that, at worst, a slight reduction in price may be asked for rather than wait for a replacement. This is not fair trading. The Army, Navy, Air Force, Police, Tramways, Railways and, generally speaking, all uniformed staffs in public bodies are allowed fixed issues of clothing. It is, therefore, necessary that standards of cloth should be provided which will give the life and service necessary, but it is also expedient, on account of expense, that the quality of the fabrics should not be so much superior to outlast to any extent the period for which they are issued.

A typical specification for a woolen cloth for uniform clothing embraces the following:

Width.
Weight per yard.
Threads per inch, warp and weft.
Breaking load (pieces 6⅝ in., 7 in. between the jaws).
Dye (nature of).
Maximum vegetable fiber allowed (if any).
Shrinkage per yard (warp and weft).
Fastness to Fugitometer Test (100 hours exposure).
Outside exposure for fading.
Rubs to Wear Test on L.I.R.A. Machine (not specified at present, being in an experimental stage).

In addition to the above there are laboratory tests for quality of fiber and yarn, counts of yarn, twist, chemical tests for fastness of dye. Then we have store tests of perching the material for weaving faults, thick yarns, thin places, broken ends and picks, uneven dyeing, etc. Having carried out all these tests what more is there to find out about the cloth?

In considering outerwear some consideration must be given to the work to be performed by the wearer. As an example, a goods porter handling boxes, parcels, trunks, etc., will require a cloth to withstand considerable friction on the front of his clothing, and for this purpose a thick woolen cloth with a certain amount of surface is necessary, otherwise a threadbare appearance will be the result after very limited wear. In addition, strength of material is essential to enable lifting heavy weights. As a contrast, for a man in a supervisory grade where manual labor is not required, a worsted cloth, of a lighter weight, would be sufficient for the purpose.

For underwear a different set of conditions obtains. Resistance to washing, perspiration and friction are the chief factors, with construction and fastness of dye closely following. These tests can be satisfactorily applied in the laboratory and serviceability generally determined. In the case of the young lady attraction is serviceability. With the young man also length of service is not the first essential of purchase but smartness and snappiness. For younger people, style plus design count for serviceability without question of cost or length of wear. It would be impossible to find suitable standards for all needs; where the appeal to the eye is more important than the purse or length of service, then serviceability becomes a problem of difficulty because no standards exist that will meet the complexity of public demands.

Many complaints of loss of color and tendering of fabrics can be traced to the misuse of new strong washing preparations. Complaints are often received that the serge used in the making of trousers has proved defective in the seat and fork of the garment. We generally find that the man cycles to and from work, and the cloth is required to withstand double the ordinary wear, yet if used legitimately is quite equal to the service required. Tendering of window curtain materials in railway carriages due to the action of light, sun and condensation has now been overcome by purchasing material that will resist condensation. Again the tendering of colored borders of dinner napkins due to the action of the dye on the fibers has caused a revision to be made in the type of napkin purchased. The crimping of artificial silk bedspreads after laundering has also been a source of trouble. The question of union cloths is also one of difficulty. For example, flax warp and hemp weft canvas was brought into existence as a standard product for railway wagon covers. Recent research work has proved that after a certain period the deterioration of the hemp is much more rapid than the flax. There seems to be a long way to go—despite our advertising that British textiles are the best in the world—before we arrive at an understanding of proper combinations of fibers, designs, dyes and other features demanded for perfect cloths.

Whilst admitting that all the factors of fabric service cannot be covered by chemical, physical or practical tests owing to the wide divergence of conditions of service, due to wearer, environment or differences in the fabrics themselves, yet they are the only methods by which quick results can be obtained.

Resistance of Fabrics to Abrasion

J. C. Mann, M.A., B.Sc., A.Inst.P.

WHEN it is considered how diverse are the uses to which fabrics (or any particular fabric) are put some of the general reasons for the difficulties inherent in the problem of devising a machine on which fabrics can be tested for resistance to wear become obvious. Even if we concentrate on any particular type of wear, the mechanism involved is complicated in so far as many factors must be considered. One simplification of the problem which has been generally adopted is to study the resistance of fabrics to abrasion, instead of to wear in general.

Such an investigation has been carried out on two knitted fabrics, used almost exclusively for ladies' underclothes, which were submitted so that their relative wearing qualities could be tested. During the investigation, five machines were made, in all of which, with the exception of one in which bending of the fabrics was introduced, the only factor in wear to which the fabrics were subjected was abrasion. The type of abrasion imparted by the various machines was very similar in that the abrasive material was either a fine grade emery cloth or carborundum.

In spite of the similarity in the type of abrasion to which the fabrics were subjected, analysis of the results obtained by testing the two fabrics on each machine in turn showed: (1) Definitely contradictory results were obtained from machine to machine, *e.g.*, whereas one machine showed consistently that fabric A withstood abrasion three times as well as fabric B, another machine showed just as consistently that fabric B withstood abrasion five times as well as fabric A. (2) Using any one machine, contradictory results were obtained by slight modifications in the conditions of test, *e.g.*, by rubbing the fabric in one direction only instead of in both directions, by alternating the pressure of the abrasive material on the sample, etc. (3) Contradictory results were obtained according as the fabrics were rubbed wale-ways or course-ways.

Although abrasion is obviously a very important factor in wear, it is not in itself the simple action it might at first sight appear to be. The effect of the abrasion present in actual wear will probably depend on whether the heat generated is dissipated or not, on the amount of moisture present in the fabric, on the presence or absence of perspiration, on the pressure of the abrasive on the fabric, on the fit of the garment, on whether static electricity is generated or not, etc., etc., etc. The second heading of difficulty of obtaining scientifically reliable data on the relative actual wearing qualities of fabrics. If the difficulty can be overcome to such an extent that it is possible to arrange a dozen or more fabrics in order from the point of view of resistance to wear, there is one last hope for the imitative wear tester. Having arranged the fabrics in order, we can try to devise, by hit-and-miss methods, a machine which places the fabrics in exactly that same order when tested in the laboratory.

The Serviceability of Fabrics in Regard to Wear

Dr. W. H. Gibson, D.Sc.

I TAKE rather a different view of the tests which Dr. Peirce calls "imitation wear tests." Surely the conditions under which such tests are done are chosen in the endeavor to limit the variable factors as far as possible and so to obtain reproducible and comparable results. Having a saleable fabric, it seems to me that the manufacturer has quite a fair chance of making improvements on it by the use of those comparative and reproducible "imitation wear tests."

Through the experience of generations we have come to use fabrics made of the textile fibers, silk, wool, flax, cotton, jute, etc., for purposes for which they have been found suitable. These fabrics are suitable for their particular purposes because of the natural or acquired properties of the fibers from which they are made and because of the structure into which they have been arranged. The customer is always right, and should know whether he or she wants silk, wool, flax, cotton or jute fabric for any particular purpose. This fabric should be available, and it should be possible for the retailer to assure the customer that the fabric is genuine. In the linen industry today we endeavor to give users, who want linen, fabrics made of pure flax, and to protect them against the substitute-monger. Control by fiber identification tests is the best way of doing this.

The question of modification of the natural fiber during processing is an important matter. The chemical tests which give an indication of the condition of the fiber are invaluable in safeguarding the interests of the user in this respect.

Considerations of yarn levelness and fabric structure have very little to do with serviceability, which is really determined by fitness for purpose. It would be absurd to limit the range of textile fabrics to plain, close, and heavy weaves, and, in fact, the demands made on the manufacturer by the good taste and individuality of his customers could not be met. There will always be a large proportion of the public which takes a pride in its clothes as a means of expressing personality and its moods. A woman will not be restricted in her choice of absurd considerations of mechanical wear. Mechanical tests are useful for purposes of comparison, but mechanical wear is not the chief consideration in determining serviceability for wear.

Fabrics in use are subjected to two kinds of wear—personal wear, and the wear involved in cleansing the garment. There is a danger that textile manufacturers may be led to attach an exaggerated importance to the "launderability" of fabrics in a washing machine. Judging from the Press, there is a movement towards hand washing of delicate garments.

The individual judges the serviceability of a garment by the number of times it can be worn and still look smart and not dowdy or old-fashioned. In brief, serviceability in wear is to be secured by ensuring that the wearer gets what is wanted.

The Serviceability of Fabrics in Regard to Wear

J. Lomax, F.I.C.

DR. PIERCE'S conclusion that imitative tests are a delusion and a snare is one with which most experienced testers will agree to a great extent. In actual practice, however, aims may be limited in two ways in that we only wish to compare one fabric with another whose performance is fairly well known. Secondly, the question of serviceability is usually confined to one destructive agency only, such as washing.

It should be remembered that tests for fastness to light and washing are imitative, and these are in constant use and give reliable results. The serviceability of a fabric to wear can probably not be foretold from the character of the fabric, stitches and courses, etc., but must be found by testing, either by actual practice or by imitative tests. Imitative tests for fastness to wearing are, however, very much more difficult than fastness tests to design and correlate with actual practice. It does not seem an impossibility to design an imitative test for, say, carpets, but cotton shirtings, for example, would require completely different tests. It does not seem certain that any one wear tester must be confined to the particular fabric or class of fabric for which it was designed.

As an example of the difficulty in forecasting the serviceability of a fabric from its character, the following example may be of interest. Of two similar cotton interlock fabrics the satisfactory one had been worn and washed for a fairly long time and still had a smooth surface; the unsatisfactory one had been worn for a short time and washed once, and the surface was rough, owing to loose cotton fibers fluffing and becoming entangled on the surface.

The yarn from the smooth wearing garment showed shorter staple and slacker twist and was cheaper. Imitative rubbing tests on the two original fabrics showed that both fluffed on the surface with wear. The fluff on the surface of the satisfactory fabric could, however, be brushed away, leaving it smooth, but that on the surface of the unsatisfactory one clung and could not be brushed away. Presumably the first fabric would wear smoother and quicker, the second fabric rougher and longer, the former, from the user's point of view, giving the greater serviceability.

The Serviceability of Rayon Crepes

W. J. Hall

IT IS sometimes the case that more information could be extracted from the tests that are made or tests which seem to have failed are successful if carried further. As an example straightforward routine tests of the strength in the warp and the weft directions showed that rayon crepes, though weak in comparison with natural silk crepes of similar weight, were sufficiently strong to meet the normal requirements in garments. The difference between the strength of the fabric in the warp direction and in that of the crepe weft is, however, inevitably very pronounced owing to the great diminution in strength of continuous filament rayon yarn consequent upon the insertion of a very high degree of twist. Such fabrics develop the fault described as "blisters" in parts of garments subject to undue tensions or to rubbing.

No rupture of the yarns, warp or weft, has taken place, and the breaking loads, either of the yarns tested as such or of the fabrics, give no clue to the source of the trouble. However, autographic load-extension curves for the continuous filament rayon warp and weft yarns showed that the warp yarn was still within its elastic limit when the weft was receiving permanent extension. This must inevitably cause blisters for stresses in this zone. The risk could be mitigated by cutting sleeves, etc., the wrong way.

The warp yarn can contract but the weft yarn is permanently stretched and must therefore cause the blisters.

Of course, the complete investigation of a fault of this nature demands the examination of the autographic load and extension diagrams given by the cloth test, but these are necessarily more complex than yarn curves. Further, the properties of natural silk and rayon have to be contrasted in order to explain why the fault rarely appears in natural silk crepes. But perhaps it is sufficient to show that a more detailed examination of the results of the established tests is of considerable importance.

(To be concluded)

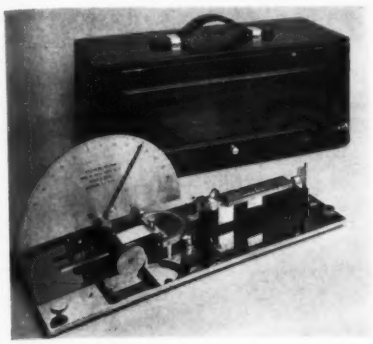
TRADE NOTES — NEW PRODUCTS

• STIFFNESS TESTER

A stiffness tester has recently been developed by Dr. Irving J. Saxl, Consulting Physicist, Industrial Trust Bldg., Providence, R. I. This instrument is said to make it possible for the first time to quantitatively predict whether the cloth will crush easily or drape readily and whether its softness will be desirable.

Instead of bending a piece of material in the hand, to evaluate by the sense of touch the resistance against bending, the instrument is said to introduce a precision bending equipment combined with a sensitive balance. The piece of cloth to be investigated is inserted in the clamp on the left side of the picture. The other end of the material rests upon one side of the balance. If the knob that holds the cloth on the left side is turned, the

right side of the strip will then press upon the pan of the balance. This pressure will be the greater, the stiffer and the harder the cloth. For a given weight, say for instance 10 grams, we have to turn the knob that holds the standard piece of cloth very little only, say 15 degrees if the cloth is stiff, but we have to turn a great deal more, say to 60 or 70 degrees deflection if the cloth is soft.



Stiffener Tester designed by Dr. Saxl

It is said to be also possible to determine, by this apparatus, the recovery characteristics of a given piece of material.

It is stated that, for the first time, it is possible to measure quantitatively such characteristics that influence the draping of fabrics, the efficiency of softening agents and the effects of processes that should lend resiliency to the cloth such as the deposition of various synthetic resins as used in the vitalizing process.

Complete details of this appartatus may be obtained from Dr. Saxl.

• GEIGY RELEASE

Geigy Company, Inc., 89 Barclay St., New York City, announces release of the following shade card:

Direct Colors Fast to Light—The dyestuffs shown have been selected from the Geigy line as representing the best resistance to light. This resistance makes them interesting for the dyeing of fabrics such as draperies, curtains, upholstery cloths, etc. It is said that they can be applied to all types of cotton goods, viscose rayon, unions, etc. It is stated that on a whole these colors are easily dissolved, have good penetration properties and level well. It is further stated that their method of application is quite simple and inexpensive and for this reason they are usually in demand wherever severe wash fastness is of secondary consideration. The fastness properties to other color destroying agencies are indicated adjacent to the swatches. Instructions for dyeing and aftertreatment are given. Shade Card No. 283-D.

• PRINTING ASSISTANT

Revertex Corporation of America reports increasing sales of their Textile Printing Assistant K57-C. This is a latex compound designed to act as a binder for the discharge pigment and its use is said to assure superior qualities in the finished cloth.

It is said that K57-C is easily incorporated in printing pastes. Its high stability is a safeguard against coagulation. The finished fabric that has been printed with K57-C has a softer feel and a better color can be obtained in pure white discharge printing, Revertex Corporation of America claims. A design printed with the aid of K57-C is said to be etched very clearly and a finish results that is free from flakes and dust.

• ELECTRIC CLOTH GUIDER

H. W. Butterworth and Sons Company, York and Cedar Sts., Philadelphia, Pa., has just announced their latest development in machines for the guiding of cloth. It is a solonoid type electric guider.

The new guider is said to operate efficiently on cloth running up to 300 yards per minute. The guider has few moving parts and all parts subject to wear have oilless bearings.

An entirely new type of electrical contact was designed to operate the guider. A movement of 1/64 of an inch is required to make and break the electrical contact. Once adjusted, this contact never needs to be reset. It is completely sealed.

The electrical operating unit of this new guider can be supplied to take the place of the valve mechanism of the Foxwell air guiders which the company has made for more than 20 years. About one-half hour is required to change air guiders to the electric type. There are no holes to be drilled.

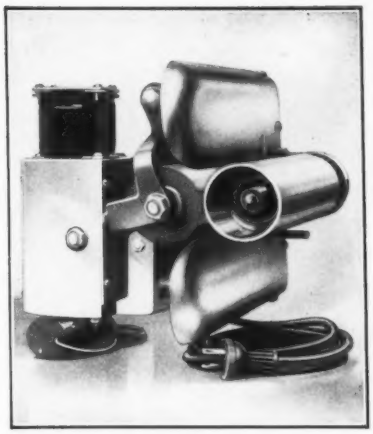
At the present time, the company is supplying the new electric guiders only for 110 volt 50-60 cycle alternating current operation. Within a few months, however, it is planned to market electric guiders for practically any voltage and cycles; also for direct current operation.

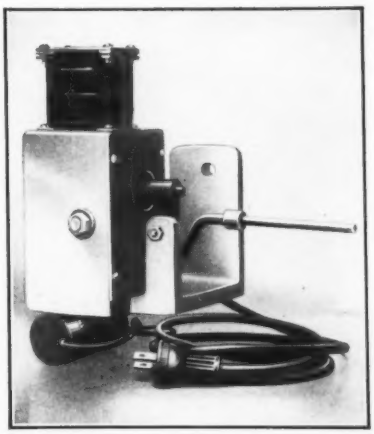
• CHEMICAL COTTON FACTORY

It was announced recently by Hercules Powder Company that a new company has been formed in England, in conjunction with the Bleachers' Association, Ltd., of Manchester, for the manufacture of chemical cotton. The association of the two companies on this project provides consuming industries in England with a larger source of chemical cotton than had previously been available. It is stated that the extensive experience of the Bleachers' Association in the textile and other industries, coupled with Hercules' knowledge of cellulose chemistry, will enable the new plant to produce quality products.

A modern plant of latest design for producing these high qualities of cellulose from cotton linters is being built under the supervision of Hercules' engineers. Hercules is supplying the technical information on the process. The production of the new plant will be used by manufacturers of lacquers, celluloid, cellulose acetate, and for other associated purposes.

The new company will be known as Holden Vale Manufacturing Company and takes its name from the section in which it is located. This is about eighteen miles north of Manchester.





The above illustrations show the new Butterworth electric guider and the conversion unit.

• WHITESTONE RE-ORGANIZATION

It is reported that the complete re-organization of the Whitestone Dye Works, Inc. of 74-16 Grand Avenue, Maspeth, L. I., was effected recently in the Federal Courts of the Southern District of New York, by making complete payment to all creditors in accordance with the re-organization plan submitted.

Outside interests of substantial financial responsibility and a thorough knowlede of the dyeing and finishing business, represented by the National Acceptance Corporation, are said to have invested adequate capital to pay all creditors and to purchase additional equipment and machinery.

Dudley C. Andrews continues in full charge of the plant and its operations. In a recent interview, he reported a very steady monthly increase in business volume and employment; alterations and improvements are being made to the building to allow for the installation of additional machinery necessary to take care of the contemplated continued increase of business.

• GENERAL RELEASES

General Dyestuff Corp., 435 Hudson St., New York City, announces release of circulars on the following products:—

Soromine S—a new softening and finishing agent for rayon and cotton. It is particularly recommended by the manufacturers for rayon crepe, hosiery and mercerized embroidery yarns. When used in the dyebath, it is said to have the property of going on the fiber substantively with the dyestuff. It is further said to be very resistant to hard water and organic acids and to resist rinsing. It is stated that it is particularly suited for softening fabrics or knitted materials of cuprammonium rayon. Three to five ozs. per 100 gallons of dye liquor are said to be usually sufficient. Circular I.G. 1376.

Diazo Brilliant Orange 3 G—which is particularly recommended by the manufacturers on account of its very good dischargeability with neutral and alkaline pastes and its very good fastness to washing. Circular I.G. 1290.

Rapidogen Golden Orange IGG—which yields a clear golden orange shade much brighter than anything so far existent in the line of Rapidogen Yellows or Oranges. The prints are said to possess excellent fastness to light and very good fastness to washing and chlorine. Circular I.G. 1348.

Rapidogen Black IT—which possesses best all around fastness on printed styles. It is said to be easily soluble, to give very stable printing pastes and to be easily developed in acid steaming. It is further said to yield full blacks of excellent fastness to light and very good fastness to washing and chlorine. It is stated that it produces very fine greys of unusually good fastness to light. Circular I.G. 1360.

• P. Q. SILICATES

The Philadelphia Quartz Co., 121 S. Third Street, Philadelphia, Pa., has recently published a booklet entitled *P. Q. Silicates in Textile Processing.* It is reported to be the first booklet of its kind ever published. A description is given of three silicate products as follows: Star Brand Silicate of Soda, Metso Detergent and Metso 22. There follows a list of ways in which the P. Q. Silicates might profitably be used in the following processing operations: Bleaching, Weighting, Scouring, Kier Boiling, Soaping Off Prints, Back Gray Washing, Cleaning Machinery, Coating Kiers, Water Treatment and Sealing and Other Adhesive Work. Copies of this booklet are available upon request.

• BROWN CATALOG

The Brown Instrument Co., Wayne and Roberts Ave., Philadelphia, Pa., has just published a new catalog on Brown Pyrometers (Potentiometer Type). This catalog includes the complete line of Brown Potentiometer Pyrometers — Indicating, Recording and Controlling. It also includes the new Brown Electroline Controllers and the Brown Proportioning Control System. Copies of this catalog are available upon request. Ask for catalog No. 1102.

CLASSIFIED

BOOK WANTED:—A used copy of "The Dyeing of Textile Fibers" by Horsfall and Lawrie, published by D. van Nostrand. Indicate price and condition. Reply to Box No. 981, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: Experienced Dyestuff Salesman Demonstrator desires connection. Now employed. Will go anywhere or would consider taking charge of dyehouse. Solicits inquiries. Write Box No. 967, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: Chemist to supervise the preparation, dyeing, finishing of rayon, acetate, silk, cotton fabrics, the chemical control, research, improvements and economy. Experience with leading dyeing, printing and finishing organizations. Write Box No. 970, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED: Wanted by a well-known manufacturer of sulfonated oils and other textile specialties chemist capable of doing research and development work. An excellent opportunity for a man with ideas and experience along this line. Write Box No. 977, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED: DYER-DEMONSTRATOR: Piece goods dyer for 15 years. All classes of dyes on Cotton, Rayon and Celanese. Specialty last 5 years Naphtols, Algosols, Vats. Pad-pigment, continuous, and jigs. At present employed on Celanese and Rayon Satins. In charge of dyehouse or demonstrating for Dyestuff company. Age 38. Married. Write Box No. 978, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

CHEMIST WANTED: Textile School Graduate. Experienced in silk and hosiery processing. Laboratory experience most essential. Not over 30 years of age. Give complete details. Write Box No. 979, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED: Manufacturer of a complete and highly developed line of finishing specialties for full fashioned hosiery mills is seeking the services of a representative with proven sales ability for North Carolina and Tennessee. Must have thorough knowledge of all hosiery dyeing and finishing problems with wide acquaintance and following in that territory. Salary, expense and bonus. Write fully giving age, qualifications, experience and references. All replies held in strict confidence. Write Box No. 980, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

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